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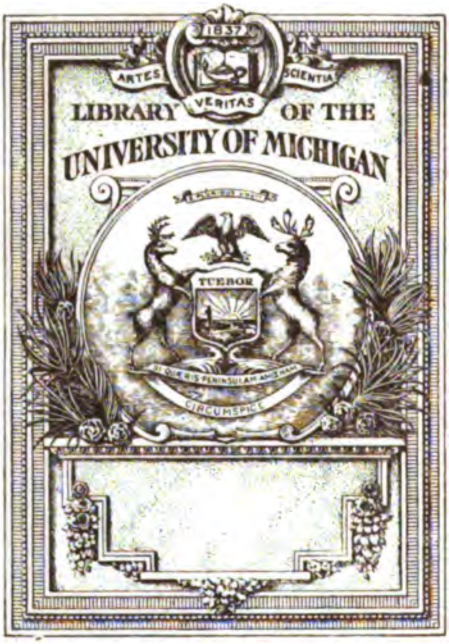
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THE
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II. Baddeley's Impts. in Manufacturing Ornamental Articles of Earthenware; Newton's. Apparatus for Producing Ice; and Lienau's Apparatus for Purifying Oils.

III. Newton's Impd. Furnaces for Treating Zinc Ores; Wood's Impts. in Paving; and Dunn's Engine for Obtaining Motive Power from Heated Air or Gases.

IV. Mead's Apparatus for Measuring Gas and other Fluids; Horton's Impts. in Constructing Gas-holders; Newton's Impts. in Metal Shutters; and Illustrations of Mechanical Engineers' Transactions.

V. Corry's Impts. in Looms for Weaving Figured Fabrics; Brown's Impts. in Pumps; and Illustrations of Mechanical Engineers' Transactions.

VI. Stephens' Impd. Thrashing Machinery; Newton's Impts. in Generating and Condensing Steam, and in Steam Engines; and Baxter's Impts. in Ships' Windlasses and Winches.

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No. CCXXXV.

THE INDUSTRIAL EXHIBITION.

GENERAL REMARKS.

THE use which the unexampled collection of industrial products affords to a community ever ready to make available all useful hints, no matter from what quarter they may be received, is now beginning to be generally appreciated; for lecture rooms have been fitted up in the Crystal Palace for the convenience of students who are desirous of collecting information on the principal manufactures of the country; and well-informed guides are, we understand, appointed, to explain to enquiring visitors the nature of the various processes, the results of which they may behold around them. This is as it should be; for when shall we ever again meet so favorable an opportunity for gaining knowledge? Thus far then are we assisted in our labor of rendering the Exhibition a means of public instruction; but as these means are evanescent, and must of necessity be very limited in their application, we are led to think more highly of our own project; and, despite the unlooked-for difficulties which are continually starting up, to add perplexity to duties which are of themselves sufficiently onerous, where the path is smoothed (as might fairly be expected) by the assistance, or at least the affability, of exhibitors or their representatives, we are encouraged to pursue our course, trusting that our labors will be eventually appreciated. In our last number the subjects which we opened up were five, viz., Raw Materials, Textile Manufactures, Musical Instruments, Labor-saving Machines, and Decorative Art. These were selected as taking in a large and diverse range of manufactures; and in the present number we shall continue the examination of the same branches of industry.

In treating of Raw Materials, we commenced with *coal,* as the *fons et origo* of our industrial wealth, and had occasion to remark on the imperfect and wasteful manner of its consumption: its conversion into coke was also conconsidered. Then came the metals *iron, copper,* and *lead;* the former of which called forth some suggestions for its more perfect manufacture. In the present number the metals *cobalt, nickel,* and *tin* are treated of, and coal is again referred to in its connection with gas-making.

Our notice of Textile Manufactures was confined to an elucidation of the principles on which this important branch of our manufactures is founded. The continuation of the subject refers more particularly to the machines in operation in the Exhibition, and will embrace the manufacture of cotton and wool into yarn.

The division Musical Instruments took up the piano-forte, and traced it from its origin to the now well-developed instrument. In the present paper will be found a review of all the English piano-fortes exhibited, which present any features deserving of comment. As literature has hitherto done little or nothing to advance this branch of the arts, we have thought it well to enter more into detail than the space at our command would at first sight seem to warrant.

Labor-saving Machines being of a miscellaneous character, we brought together those which were applicable to the same or connected branches of industry—thus, a notice of two envelope-folding machines led to the introduction of a pamphlet-folder, and this to apparatus for paging and numbering books. In continuing this paper the connection of one subject with another will occasionally be lost, but it will be seen that unity is preserved as much as possible.

The paper on Decorative Art—in addition to forming an introduction to a very wide subject, the importance of which has only recently been generally recognized—treated of carpets and tapestry, which gave occasion for some remarks upon the nature or quality of the ornamentation most appropriate for the former manufacture. The present paper will treat of the decoration of china, pottery ware, and glass.

When it is considered over what a wide field our enquiries must necessarily spread for every subject treated, it is hoped that exhibitors, who have left their contributions to speak for themselves, will not feel chagrined if their special merits have not been appreciated at a glance by a stranger; or that bandaged or cased-up ingenuity should go unnoticed.

RAW MATERIALS.

Mingled with the beautiful samples of copper pyrites and argentiferous galena displayed in Class I. of the Great Exhibition, there are to be found several specimens of cobalt and nickel ores. These valuable articles lie buried beneath the huge bulk of their better known compeers, and, unless sought for, will fail to arrest the attention even of a scientific observer; thus singularly illustrating in the Crystal Palace the obscure position they occupy in the manufacturing industry of the nation. The art of working the ores of cobalt and nickel seems unknown in Great Britain, if we may judge by the fact that, though found in sufficient abundance, they are nowhere in this country converted into zaffre and speiss, the two primary marketable products elsewhere obtained from these ores. Although, therefore, no nation in the world consumes, in its manufactures, more cobalt and nickel than Great Britain, yet for these metals it is entirely dependent upon Norway, Northern Germany, and the Netherlands; from whence we import annually not less than 400 tons of zaffre and smalts, and nearly the same quantity of nickel and speiss, to the conjoint value of about £150,000 sterling. As these substances serve very different purposes in the arts, we propose to speak of them separately,—merely premising that cobalt forms the basis of all the blue colors seen on earthenware, whilst nickel is an indispensable ingredient in the various metallic alloys, known under the terms albata, German silver, &c. The specimens of ore previously alluded to, as existing in the Great Exhibition, have been derived from Cornwall, and contain, as is generally the case, both nickel and cobalt; thus far being precisely similar to the ores worked in Norway and Northern Germany. The foreign ores are, however, much richer than the Cornish, since these latter seldom contain more than from 2 to 7 per cent. of available metallic matter, whilst the former not unfrequently yield 12 or 15 per cent.; consequently, a process which answers quite well with the one may fail altogether, or prove profitless with the other; and this is exactly the whole secret of our national failure in working cobalt ore. The Swedish method has been tried in several parts of Cornwall, and has not in any one instance given a satisfactory result; hence, the Crystal Palace contains no specimen of British zaffre; and our potteries, glass works, and paper manufactories, procure from abroad that which ignorance and apathy deny them at home. In the German ore the quantity of metallic ingredients is not only larger than in the Cornish, but also of a more fusible character; consequently, when simply subjected to heat in a reverberatory furnace, the earthy and metallic elements separate of themselves by the mere disparity of their specific weights; and the silicious gangue, with a portion of oxide of iron, rises to the top; leaving a metallic compound of arsenic, cobalt, nickel, copper, and perhaps iron, beneath. This latter, when carefully roasted in an oxidizing furnace, in contact with sand or ground flint, affords at once an impure silicate of cobalt and arseniuret of nickel—two marketable products. The Cornish ores, from their metallic poverty, will not undergo the first fusion necessary to separate the silicious matrix of the mineral; and this trifling impediment seems actually to have benumbed the energy of that indomitable spirit of enterprise for which Britain is in most things justly celebrated. In the manufacture of iron, limestone is used to render the alumina and silica of the ore fusible; and without this no iron can be procured by the ordinary process. In roasting lead ore, lime cannot be dispensed with. In copper making, not only lime but also fluor spar is frequently needed; and the commonest cobalt ores of Cornwall clearly require nothing but a proper flux to afford a compound of arsenic, cobalt, and nickel, perfectly analogous to that procured from the German ore by mere fusion without a flux. The whole question, therefore, really resolves itself into the discovery of a cheap material capable of easy vitrification with the granitic matrix of the Cornish ore, and which is nevertheless devoid of action upon the arseniurets of cobalt and nickel. The common fixed alkalies, though answering the first indication admirably, would not comply with the second condition; hence potash and soda—these great helpmates of industrial skill—are unfortunately excluded from the list of agents, as they act powerfully upon all the arseniurets, and would merely produce a worthless frit with the ore. Similar objections attach more or less to the alkaline earths, and therefore lime requires to be looked upon with suspicion. Borax would and does yield a satisfactory result, but its high price is an insurmountable obstacle. Fluor spar is of no avail, and bottle glass requires too strong a temperature, and to be used in too great a quantity, for economical application to a mineral already surcharged with extraneous matters.

These facts serve in some measure to explain, though we cannot allow that they in any way justify, the present condition of the zaffre market; since these very difficulties are daily overcome in one of the largest metallurgical operations carried on amongst us. Many of the ores of copper, when first received by the manufacturer, are in a state quite parallel to that of the Cornish ores of cobalt, even in regard to poverty of metal. There is the same excess of granitic matrix, the same necessity for avoiding the use of any agent capable of attacking sulphuret of copper, a substance possessing very similar chemical affinities to those of the arseniurets of nickel and cobalt. What then is the flux employed by the copper manufacturer in such cases? We reply at once, it is the protoxide of iron, which is formed from these poor copper ores by the action of heat, and combines with the silica of the matrix so as to produce an extremely fusible silicate of iron, which permits the sulphuret of copper to fall down to the lower part of the reverberatory furnace, whilst the vitrified impurities of the ore are raked from its surface. Oxide of iron would most probably therefore enable a manufacturer, accustomed to furnace operations, to send into the market an arsenical compound of cobalt containing more than 50 per cent. of this metal, even if his interest failed to convince him of the great advantage resulting from its subsequent conversion into zaffre. Thus then the conditions of this seemingly difficult problem are answered, in a commercial sense; for oxide of iron is plentiful and cheap, its combination with silica is sufficiently fusible, and it has no action whatever upon metallic arseniurets. No doubt many other substances might be found equally applicable with the one we have mentioned; and, indeed, our object in thus dilating upon this and analogous topics is rather to stimulate inquiry than lay down specific rules for practical guidance; consequently our remarks must be regarded at best as but a shadowy outline, the manufacturing details of which require careful filling in, to render the whole intelligible and useful.

Before quitting the subject of cobalt, it may be as well to advert to a peculiar ore of that metal, found near Keswick, in Cumberland. This ore contains from two to three per cent. of cobalt, but is quite free from nickel, a very unusual circumstance; as even in meteoric stones cobalt is constantly accompanied by nickel, though this last metal not unfrequently exists without cobalt. As a coloring material oxide of cobalt is seriously damaged by the presence of oxide of nickel, for these oxides produce colors almost complimentary to each other; and therefore tending, by their admixture, to yield a neutral tint, as is observable when their saline solutions are united. The great advantage of working an ore of cobalt free from nickel must, consequently, be obvious to all. The Keswick mine is, nevertheless, almost abandoned at the present moment, through sheer inability to find a market for its produce; though for the finer kinds of porcelain, and for enamel painting, the oxide of cobalt, procured from it, is worth fully a guinea per lb.

In the hope of drawing attention to a raw material, at once so unique and valuable, we give the following original process for extracting pure oxide of cobalt from the Keswick cobalt ore:—Having carefully roasted a quantity of this ore, at a full red heat, in a muffle furnace, for two or three hours, it is next to be reduced to a fine powder, and then digested in muriatic acid of the specific gravity 1·10, or thereabout. And for this use the waste acid of the soda-maker is well adapted, even though it may happen to contain arsenic and iron. After a few hours digestion, the acidulous solution may be poured off and fresh acid added, so as completely to exhaust the roasted ore, and dissolve all the metallic matter in it. Then mix the solutions thus procured; and, having thrown in a portion of powdered hœmatite or other form of peroxide of iron, evaporate the whole to dryness. Next pour boiling water on the dried mass, and stir in an excess of chalk, whiting, or finely-powdered marble, and preserve the whole at a temperature of about 180° Fahr., until all evolution of carbonic acid ceases; then add a quantity of sulphate of soda and throw the mixture on a filter, when a solution of chloride of cobalt will pass through, containing a small quantity of the sulphates of lime and soda, but altogether free from metallic contamination. This solution must now be supersaturated with a caustic lye of soda, and the mixture boiled for a few minutes, in order to insure the rapid precipitation of the oxide of cobalt; which, after careful washing with hot water, is to be dryed and heated red hot, in a crucible, to give it the character suitable for the English market. One pound of Keswick ore will require about eight ounces of muriatic acid, of the kind alluded to, with two ounces of hœmatite, three ounces of chalk, and the same quantity of salt cake or dry sulphate of soda. The explanation of this process is very simple: in the first instance the metallic matters of the ore, consisting of iron, cobalt, arsenic, copper, and perhaps also lead, are dissolved by the muriatic acid; and, as all of these are precipitated by carbonate of lime, except cobalt, the chalk might now be added at once, but for the fact that the Keswick ore contains an excess of arsenic, which carries down a portion of cobalt in the state of arsenite of cobalt. To remedy this evil peroxide of iron or hæmatite must be added, so as to insure the existence of an excess of peroxide of iron in the solution; as this, on the introduction of the chalk, will unite to the arsenic and thus prevent the precipitation of any cobalt at this stage of the operation. The cessation of all effervescence indicates that the chalk has ceased to act, and that the iron, arsenic, copper, and lead are no longer in solution, but have been displaced by the lime of the chalk. To remove this lime, sulphate of soda is employed, since this throws down nearly the whole of the lime in the state of sulphate; after which caustic soda or potash will precipitate nothing from the filtered solution but pure oxide of cobalt. Although apparently somewhat complex in detail, this process is extremely simple and efficient in practice; and possesses, moreover, the advantage of being equally applicable to the treatment of speiss or arseniuret of nickel, from which pure oxide of nickel may easily be procured,—using, however, much more hœmatite than the quantity indicated above, in consequence of the absence of iron in speiss. From this latter circumstance it must be obvious that cobalt and nickel cannot be separated in the way just described; for, as has been stated, they both remain in solution after the employment of the chalk; and, indeed, no process has yet been published by which a perfect separation of these two metals can be effected. Ordinary Swedish zaffre contains, on an average, 15 per cent. of oxide of cobalt, mixed with about 3 per cent. of oxide of nickel; which latter seriously impairs the coloring power of the zaffre. Hence it is that we have entered thus fully into this question; for as it is almost impossible to purify cobalt when contaminated with nickel, it is a kind of national disgrace to Great Britain that, having a pure ore of cobalt in the very centre of the island, our manufacturers are unable either to compete with, or so much as contest for, the palm of superiority in the formation of zaffre.

The only other metallic minerals of any consequence remaining to be noticed in Class I. of the Great Exhibition, are those of tin; and these well illustrate the great difficulty of improving, or even suggesting an improvement, in an old established manufacture. Substituting charcoal for the common coal, now used, it is every way probable that the mode of reducing tin ore, practised by the Phœnicians more than 2000 years ago, was almost identical with that pursued at present in Cornwall. Of course improvements have taken place in the apparatus for washing and grinding the ore, and in the form and construction of the furnaces. But these, after all, are mere corollaries upon other manufactures, and present no such marked change as may be seen in many other things; for example, in the puddling of iron, or the formation of glass. The extraction of tin from its ores is too simple an operation to admit of any very decided alteration for the better; and the only modern invention worthy of that name, is the fabrication of the alkaline salts of tin from the ore direct, instead of, as heretofore, from the metal itself. Thus the stannate of soda, a substance pretty freely used in dyeing and calico printing, is now made by merely boiling the native oxide of tin, or tin-stone, as it is called, in a caustic solution of soda; by which the oxide is dissolved, and unites with the alkali, to form stannate of soda. An example of this new development of industry is exhibited in Class II. of the Crystal Palace, where Mr. Young, of Manchester, displays both a model of the apparatus he employs, and samples of stannate of soda thus produced. It might be conjectured that, in an art so delicate as dyeing, some danger was to be apprehended, lest any silicic, tungstic, titanic, or arsenious acid might be occasionally taken up from the ore; but experience seems to prove, either that this is not the case, or that these substances do not impair or alter the proper action of the stannate of soda.

Immediately abutting, as it were, on the confines of raw material, the manufacture of coal-gas claims attention, from its amphibious position and multifarious uses. As bituminous coal, when subjected to the action of a red heat, invariably gives off gaseous matter wherever placed, it becomes necessary to distinguish between the production of coal-gas and its manufacture. Our ancestors were producers of coal-gas; but the manufacture of this important agent belongs to the present century; and therefore we are able, without any difficulty, to speak of the production and manufacture separately. The production of gas from coal depends altogether upon the application of a high temperature; for, at a heat verging on 400° Fahr., the volatile constituents of coal pass off in the shape of fluid hydrocarbons, or naphtha, with little or no admixture of any permanent gas. If, however, the temperature employed be that known as a full cherry-red heat, or something higher, then the volatile constituents are, for the most part, resolved into permanently elastic fluids or gases, with a trifling production of tar and naphtha. Too high a heat is however apt to induce some grave inconveniences, as will appear farther on; and hence the gas maker, in its first process, sails between a kind of Scylla and Charybdis, having to dread an excessive production of tar on the one hand, and the evils just alluded to on the other. Presuming, however, that the proper temperature has been secured, the successful production of good coal-gas is not yet ensured, unless the coals, before their introduction into the retort, are free, or nearly so, from water. Coal is a bad conductor of heat; and therefore, when a quantity of this substance, in a wet condition, is thrown into a red-hot retort, as practised by gas manufacturers, the outer portion of this mass becomes carbonized and converted into red-hot coke long before the water in the centre of the coal has been expelled; consequently, as the heat penetrates through the coal, this water is vaporized and driven in the form of steam over the red-hot coke on the surface, with the production of three gases, viz., hydrogen, carbonic oxide, and carbonic acid,—all of which are injurious to the gas maker: the two first, by diluting his gas and lowering its illuminating power; the last, by neutralizing the lime contained in the purifier; and thus needlessly causing an increased consumption of that article. But the presence of water in coal is also detrimental in another way; for its conversion into steam implies the absorption of an immense amount of heat, since the latent heat of steam is upwards of 960; consequently, as this absorption takes place immediately previous to the decomposition of the bituminous constituents of the coal, a disposition results to generate at that time a temperature capable only of producing tar or naphtha, but scarcely equal to the formation of coal-gas; and thus water not only tends to reduce the quality, but also to lessen the quantity of gas procurable from any given coal; therefore its absence in coals intended for gas purposes, should always be ascertained prior to their employment.

We have previously remarked, that too high a temperature ought to be avoided in the production of coal-gas, and this for two very important reasons. In the first place, heavy carburetted hydrogen, or olefiant gas, is decomposed at a white heat, or even under this, with the formation of light carburetted hydrogen, and the production of charcoal or carbon; thus greatly diminishing the value of the gas as an illuminating agent. The second reason is still more conclusive:—All coals contain iron pyrites, which, at a low red heat, is decomposed into protosulphuret of iron and free sulphur;—the latter, uniting to a portion of the hydrogen of the coal, passes off, and is found in the gas in the shape of sulphuretted hydrogen, leaving the protosulphuret of iron in the retort. But it will be remembered that, in speaking of coke, we mentioned that this protosulphuret of iron was resolved, by a high and long-sustained heat, into metallic iron, which remained in the coke, and into bisulphuret of carbon, which escaped. Now, the application of a high heat in gas making has exactly the same effect as in coke making, and produces, in both cases, bisulphuret of carbon, which, mixing with the coal-gas, can never afterwards be removed. It consequently remains in the gas; and, when this is burnt in the ordinary way, gives rise to the production of sulphuric acid, or oil of vitriol; and this, although generated by most of the common gas of our streets in an infinitessimal quantity, is nevertheless found sufficient, in a few years, to attack and destroy the binding and paper of the books in our public libraries, and corrode articles of iron, steel, brass, or copper. This important fact has not received a proper share of consideration from our best gas engineers until within the last few months; and hence many of the old libraries of London can now furnish books completely discolored and rotted through a great portion of each page, though, in a few years, all further traces of this mischievous effect of gas will have vanished.

Having thus far commented on the production of coal-gas, we next pass to the examination of the processes employed in rendering it pure and fit for the uses to which it is applied in common life. The first process is that of condensation, by which nearly the whole of the vapours, properly so termed, are condensed and separated from the permanently-elastic gases. By this means, tar, water, naphtha, carbonate, muriate, and hydrosulphate of ammonia, are removed from the gas,—the only impurities of which now are, carbonate of ammonia, carbonic acid, and sulphuretted hydrogen. Water alone will remove all three of these impurities; but its action is weak, and chiefly exercised upon the first. Hence, although usefully employed for attracting carbonate of ammonia (as exemplified in Lowe's scrubber), it is not used by gas engineers of the present day with a view to total purification,—this being sought for in the superior affinity of lime, after the ammonia has been arrested by other means. Coal-gas, after condensation, usually contains about 2 per cent. of carbonic acid, and 1 per cent. of sulphuretted hydrogen; but these vary, of course, with the nature of the coal; and also, as we have stated above, with the dryness of the coal, which has much to do with the production of carbonic acid. These proportions may, however, be regarded as a fair average of Newcastle coal-gas, and would justify the consumption of about 40 lbs. of lime for every 10,000 cubic feet of gas,—a quantity which, although far below the proportion expended in common practice, is really very near the consumption of lime actually carried out at the Westminster station of the Chartered Gas Company, by Mr. F. J. Evans, during a long course of carefully-conducted experiments; and ought, therefore, to be kept in view as an ultimatum by gas engineers. Where much more lime than this is found indispensable to good purification, there is reason to suspect either that the coal is damp, or that it contains more than an average quantity of sulphur. The amount of sulphur in good Newcastle coal is as nearly as possible 1 per cent. by weight, and in some of the Cannel coals it is even less; thus, Boghead cannel, for example, has barely one-half a per cent., or ·54 of sulphur, on an average. How necessary then is it that every gas engineer should be able to determine the quantity of sulphur existing in coal! but even this, without other knowledge, is worthless and deceptive. Sulphur seems to be present in coal in two states;—the one and most frequent is that in which it is united to iron, as bisulphuret of iron or pyrites; the other is in a doubtful state of combination, but probably it exists conjoined to the bituminous elements of the coal in the state of sulphur. To the gasmaker this difference is very important, as in the former case one-half only of the total sulphur would pass away with the gas and contaminate it, whereas, in the second, the whole would be carried to the purifying vessels; consequently, in determining the amount of sulphur in coal, a gas engineer must ascertain first how much sulphur the pure coal contains, and next how much sulphur remains in an equivalent of the coke of such coal; after which the latter must be deducted from the former to get at the sulphur contamination of the coal when its value for gas purposes is sought to be determined.

The following detailed explanation will furnish the gas engineer with a means by which coal may be analyzed, with a view to the object in question:—Having carefully reduced a fair sample of the coal to a very fine powder, mix 100 grains of this powder with 50 grains of pure and dry carbonate of soda; after which, place the mixture in a clean iron ladle, and roast the whole over a brisk fire, at a good red heat, for several minutes, so as to burn off the whole of the coal, or nearly so; then remove the ladle from the fire, and when it is cold add 50 grains of pure and powdered nitre, mixing this well with the residue of the coal and carbonate of soda; after which, place the ladle again on the fire and keep it red hot for a few minutes, when it must be again removed, suffered to cool, and its soluble contents washed out with water and thrown on a filter. To the filtered liquor an excess of pure nitric acid must be added, and then a solution of nitrate of baryta dropped in until all precipitation ceases; when the sulphate of baryta, thus formed, may be allowed to settle, or be thrown on a counterpoised filter, washed, dried, and weighed. Its equivalent, or 117 grains, indicate 16 grains of sulphur.

Having thus determined the quantity of sulphur in the coal, 100 grains more of the powdered coal are to be taken and placed in an earthen crucible, provided with a closely-fitting cover; when the cover is put on, the crucible is subjected to a red heat until inflammable gas is no longer evolved; the crucible must then be removed from the fire and covered up in dry sand to cool. As soon as the crucible is cold, remove the coke it contains; and, after reducing it to a fine powder, mix with it 50 grains of pure and dry carbonate of soda; place the whole in an iron ladle, and proceed exactly as indicated above with respect to coal. The amount of sulphur found in the coke must then be deducted from that previously ascertained to exist in the coal,—the difference being the true sulphur contamination of the coal under examination.

In our next we shall continue the subject of coal-gas purification, with remarks upon the different methods of burning gas, and the results thence ensuing.

TEXTILE MANUFACTURES.

In resuming the subject of textile manufacture, we shall direct the reader's attention, firstly, to the cotton machinery; commencing at the extreme west of the building. Here we observe the extensive series contributed by Messrs. Hibbert, Platt, and Co., of Oldham, in illustration of the various operations in preparing and spinning cotton. The first operation, as we have previously observed, is that of opening the entangled locks, and of partially freeing the fibres from extraneous substances. Instead of the "willy," commonly employed for this purpose, Messrs. Hibbert and Platt exhibit a novel apparatus of American origin. The principle of action in this machine is, that it draws the cotton between spiked and fluted rollers, so as to loosen the matted fibres by a drawing action, instead of by a rapidly-revolving beater; the portions of seed and other impurities being separated by the rotation of other fluted rollers, which revolve against the fibres as they are held by the spikes, and thus effect the required cleaning. The cotton, as it comes from the bale, is spread upon an endless travelling apron, which carries it forward and delivers it into the machine.

In the next machine, for further opening and cleansing the material, two arrangements are included, which are not generally employed, except by this firm. The scutching action is accomplished in the ordinary manner,—the impurities falling below through an iron grating; the opened locks, however, having arrived at the other end of the machine, pass over, instead of under, the exhausting apparatus, so that the dust, removed therefrom by the draft, is not compelled to pass through the sheet of cotton. There is also a peculiar arrangement of rollers, between and partly around which the web of cotton is conducted previously to being wound into a lap;—the design being to effect a more perfect calendering or consolidating of the fibres.

It will be observed that six carding-engines, which effect the next process, are exhibited; two of these only, however, are necessary to complete the perfect operation they are designed to effect,—the remaining four being added merely for the purpose of supplying a sufficient quantity of carded cotton to meet the demand of the machinery subsequently used. Referring then to two of these, the first used is called a breaker, and the lap of cotton from the last machine is placed so as to revolve in a portion of the framework, to effect an unwinding. According to the usual method, the material would pass through a pair of rollers, which, by their revolution, bring it under the action of the machine; here, however, the "patent feeder" is employed, consisting of a roller and concave surface, between which the sheet of cotton passes; and is from thence taken by a roller, called the licker-in, covered with wire cards. From this roller the fibres are stripped by the revolution of the large central carding-cylinder, and again teazed and straightened by the action of other revolving carding surfaces. In many instances the whole process is accomplished by these means. In the case, however, of the exhibited machinery, now under notice, there are, in addition to the rollers, a series of stationary surfaces, covered with wire cards, and having a concave form, corresponding to the periphery of the large revolving cylinder. The material passing between these combing surfaces, the one brushing over the other, becomes further straightened and separated, so as to be regularly diffused over the main carding surface; it is then removed therefrom by the doffer, and subsequently stripped, in the form of a light fleecy sheet, by the rapid chopping action of the doffer-comb. A trumpet-shaped orifice then narrows the sheet of cotton into a spongy cord, which is delivered by a set of revolving rollers into a receiver placed below. This, in many instances, is simply a cylindrical can, sometimes provided with a rising and falling plunger, which, by pressing upon the top of the material, effects the stowage of a greater quantity than could otherwise be received into the can. The patent "coiler" of Messrs. Tatham and Cheetham is now, however, fast superseding the old arrangements; and the estimation in which it is held is evinced by the fact of its application, instead of the old system, to all the preparing machinery in motion of the Exhibition. The construction of this apparatus, as adopted by Messrs. Hibbert and Platt, somewhat differs from that of the original patentees, but the principal of construction is the same. The sliver delivered by the rollers passes through revolving surfaces, which thus carry it round, and deposit it in circles within a can placed below; this can, however, not being stationary, but revolving upon a centre, excentric to the centre of motion of the delivering surfaces, carries onward the sliver as it falls; and thereby, instead of allowing it to form a cylinder of cotton, disposes it in a series of coils throughout the area of the can. As the can becomes filled, the material rises against a plate at top; and the operation still proceeding, effects a pressing down of the sliver, so as to produce a condensation of the coils. A number of cans, thus filled, are taken to a machine, which will be observed on the north side of the compartment of cotton machinery. Here a sufficient number of slivers are drawn by a pair of rollers from their cans, and wound side by side upon an axle, so as to form a lap; the fibres in some measure adhering to each other, and thus constituting a sheet of the material. Laps, thus formed, are taken to the other range of carding-engines, and there undergo another operation of teazing and straightening; and then pass off through a conical tube, so as to be narrowed, as before, into a spongy cord. The slivers, which constitute the lap for feeding this machine, are from thirty to forty in number; but are admitted so slowly as to be carded down to such an extent that the sliver removed from the doffer is equal to one only of the number of slivers which entered; and thus any irregularity that might have existed in a portion of the feed is so much diffused as to be nearly, if not entirely, lost.

We have before spoken of the drawing-frame—the next machine employed—as of vast importance to the cotton manufacture. This machine has, since its introduction, undergone great improvement, principally by the application of a "stop-motion," which arrests the action of the machine immediately the breakage of a sliver takes place: this arrangement is applied to all the exhibited drawing-frames. A number of the cans from the finishing carding-engine are arranged at the back of the machine; the slivers from these pass over a series of conductors, termed "spoons,"—several slivers being drawn over together. These instruments are weighted guide-levers, mounted so as to be capable of turning upon centres; but during the proper working of the machine are kept in a certain position by the tension of the slivers which are in process of being drawn. Upon a breakage therefore taking place, or upon a can becoming empty, the equilibrium will be destroyed, and a part projecting from the under side of the spoon will, on the spoon falling, intercept the motion of a vibrating bar, which, being thus arrested, effects, by an arrangement of apparatus designed for the purpose, the shifting of the driving-strap from the driving to the loose pulley, and thereby stops the action of the machine. To this machine, the patent coiler, mentioned in reference to the carding-engine, is also applied,—the drawn slivers being again deposited in revolving cans.

The slubbing and roving-frames next come under notice. Those exhibited by Messrs. Hibbert and Platt are three in number,—the two first being distinguished by the term slubbing-frames, and the other by that of the roving-frame. The operation and arrangement of machinery, however, are substantially the same; the only object of the processes being gradually to reduce the sliver, and impart to it a sufficient amount of solidity suitable for the action of the spinning-frames. This class of machine is most fully represented in the Exhibition, and the particular point to which the stream of inventive genius is now directed is distinctly shewn. The beautiful mechanism of the slubbing or roving-frame appears, as far as its simplicity of construction and efficiency of working is concerned, to have arrived at a point beyond which there is but little to desire. Invention has therefore of late been directed solely to increase its quantitative producing power. The limit to this had been the velocity at which the revolving spindles and their "flyers" could be driven. In three out of the four exhibitors of cotton preparing machinery in motion, we find evidence of an earnest attention to this subject. In the series now under review, the desired end is sought to be accomplished in two ways; first, by reducing the top of the flyer so as to enable the bobbin to traverse higher than usual, and thus avoid the necessity of carrying the flyer legs so far downwards; which, being thus reduced in length, will admit of being driven at a higher speed without increasing the vibration. The second method is by placing the bevil-pinion, which drives the bobbin, upon a fixed socket instead of upon the spindle; by which method the vibration and the wear of the spindle is diminished. These improvements are said to enable the manufacturer to increase the driving speed of the spindles one-fifth beyond the ordinary velocity attained. To the slubbing-frames of Messrs. Hibbert and Platt is attached a stop motion similar to that we have mentioned as commonly applied to the drawing-frame. The motion of the machine is therefore arrested immediately upon the breakage of a sliver. In our general description of the cotton manufacture we spoke of the sliver as proceeding direct from the leg of the flyer to the bobbin. This plan is frequently adopted, and particularly in mills where the finest yarns are spun. In those machines, however, now under review, the presser principle is adopted. On this plan, the legs of the flyers carry an arm called a "presser," which receives an inclination to move inwards by the action of a spring, so as to bear against the surface of the bobbin. The slivers pass down the legs of the flyers, and are coiled around their respective arms, threaded through eyes formed therein, and from thence are conducted to the bobbins. The action of the spring-presser is to consolidate the roving, and thereby to increase the capacity of the bobbin for holding the roving, and prevent the necessity for frequently changing the bobbin. This arrangement is distinguished as the presser bobbin; and the other as the soft bobbin.

The next in order of the machines to be noticed, are those for spinning, both principles of which, viz., the mule and the throstle, are exhibited in this series; the former also being illustrated by two machines,—the one for the production of weft, and the other for warp. We have already in our introductory paper explained the peculiarities of these two constructions of spinning machines, the operation of the throstle being continuous, and having its spindles mounted in a stationary frame, and the spindles of the mule being mounted on a carriage which alternately approaches to and recedes from the delivering rollers. The throstle exhibited by Messrs. Hibbert & Platt presents no features that call for particular comment; but in the mules we notice that a peculiar arrangement of "scavenger" is applied. The object of this apparatus is to clear particles of waste from the top of the carriage; and the operation is effected by means of a roller, which, instead of sweeping the refuse towards the cops, moves it away in an opposite direction. The construction of these mules is on the principle of Sharp and Roberts' patent: they are provided with an adjustable cam for "backing off," and also an apparatus applied to the front roller for preventing the threads from becoming snarled.

Messrs. Parr, Curtis, and Madely, of Manchester, exhibit several preparing and spinning machines. The first of these, the carding-engine, is provided with a motion for traversing the conical tube which conducts the sliver from the doffer cylinder, and thereby causes it to be taken up by the delivering-rollers at varying parts of their length: this is the patent of Messrs. Lakin and Rhode.

In the drawing-frame there is a peculiar arrangement of spoon for the stop motion: the lower part is formed as a fork; and under the space between the prongs stands out a projection from the vibrating shaft, which, when arrested in its movement, causes the stoppage of the machine. The spoons held up by the passing sliver fall vertically upon a breakage taking place, and thereby intercept the vibrating projection with one or other of their prongs, and consequently arrest the motion of the machine.

In the slubbing-frame a spring is applied to the presser, differing from those commonly employed,—it being, in this instance, formed as a coiled watch-spring. This arrangement is intended to effect a more equal pressure, and a reduction in the weight of the flyer. In this machine also the tension weight, for tightening the cone-strap, is carried by a frame, which moves upon a part attached to the beam, instead of allowing it to rest upon the grooved shaft: there is also an application of gearing to the shortening and traverse motions. All of the improvements are shewn applied to a roving-frame. Upon approaching one of these machines, the visitor is struck by the comparatively little noise made by their working; and upon enquiry, he finds that the toothed wheels, which drive the bobbins, are composed of gutta-percha: this is the patent of Messrs. Tatham and Cheetham; and if, as at present seems probable, the material should be found sufficiently lasting, a most desirable end will have been accomplished by its introduction.

There are three self-acting mules, exhibited by Messrs. Parr, Curtis, and Madely. In one of these, the apparatus generally adopted for producing the changes required for spinning, is substituted by an arrangement which is positive in its action; and thereby prevents the common breakages of bands, and the general injury of the machine. The cords are also prevented from rubbing against each other, and thus rendered more durable by the application of an extra scroll.

Another improvement, belonging to this mule, relates to the arrangement for putting down the yarn by the "faller;" the object being, to prevent a recoil when the "backing-off" takes place; thus preventing a snarling or damage of the yarn. The "squaring-shaft" is, in this machine, driven by gearing instead of bands, as usual.

Another self-acting mule exhibits an improvement upon that principle known as Smith and Orr's. The present construction dispenses with the friction or differential motion for winding on the yarn, and substitutes an application of the radial arm, arranged so as to prevent breakages of the mangle-wheel. The rollers, driven independently of the mangle-wheel, necessarily prevent a strain thereon: they may be put in motion or stopped at pleasure; and as they derive their rotation from the driving-pinion, a more uniform action is obtained. This mule also is driven by one strap, instead of two.

The third mule contains a new arrangement of the patented improvements of this firm,—a new motion for winding on the yarn with a self-regulator being applied; the design being, to enable a person, capable of "pieceing ends," to superintend the machine, and reduce the making of a set of cops to as easy a task as the making a set of bobbins on a roving-frame.

We next arrive at the machinery of Mr. John Mason, of Rochdale: here we find a drawing-frame, with patent coiler; and also slubbing and roving-frames. The two last-mentioned machines are fitted with an improvement for obtaining a greater velocity in the rotation of the spindles. This consists in firmly attaching to the copping-rail, tubes, over which the bobbins pass,—they being hollowed out sufficiently large for that purpose. The spindles pass through the tubes, and run in contact with the internal periphery thereof at top and bottom; by which arrangement, two bearings are obtained a considerable distance apart, affording a support productive of great steadiness of action. It is stated that, with the application of this arrangement, the spindles of roving machines, where the lift of the bobbin is six or seven inches, may make from 1,200 to 1,400 revolutions per minute. This improvement is exhibited as applied to a frame where pressers are used; and also to one arranged for the production of soft bobbins.

Another improvement in these machines, is the application of a plate, situated before the delivering-rollers, and through which the rovings pass on their way to the bobbins. This is for the purpose of preventing an entanglement when an end becomes broken,—an inconvenience which frequently occurs in the ordinary arrangements. The perforated plate effects this by forming a shield, which keeps the broken roving from falling downwards to the other threads. To these machines an apparatus is also applied for disengaging the parts which drive the bobbins or spindles from the other parts of the machines; so that the whole series may be turned at once by hand when the bobbins are full, for the purpose of unwinding a sufficient length of each thread, for forming an attachment to the fresh bobbins.

In front of Mr. Mason's machinery will be found that of Messrs. Higgins and Sons, of Salford. The roving-frame of this firm exhibits another instance of the attention paid to a gain of speed in the revolution of the spindles. According to the usual practice the spindles are formed of the same diameter throughout the upper part of their length; but in the roving-frame now spoken of the spindles are formed of varying diameters, decreasing towards the top, which configuration admits of their being driven at a greatly-increased velocity, without an extended vibration: the flyers also are so attached that the bobbin may traverse to a higher point than usual; and thus the legs are decreased in length, and consequently reduced in weight, possessing at the same time a stiffness which will bear an increased rate of revolution. The conical pulley is mounted upon a frame which swings upon centres,—so that at whatever diameter the strap may be situated it will always be distended.

In the compartment containing the machinery we have described are some cases of spindles and flyers of various constructions now in use; amongst these is one which, as it bears upon the subject of increased speed, we will particularize: this is the invention of Mr. William MacLardy, of Manchester. The object sought is here attained by causing the spindle to run in a top bearing, so as to effect a greater steadiness of action; and in order to provide for the removal of the filled bobbins, the spindle is formed in two portions which are temporarily connected together: their separation is accomplished by lifting the upper part in its top bearing; when, the lower end being turned in its bottom bearing so as to occupy a position out of a right line, the filled bobbin may be slipped off. We are informed that these spindles are running at a considerably-increased velocity.

Messrs. Sharp Brothers, of Manchester, exhibit a throstle spinning-frame on the "ring and traveller" principle. This machine is of American origin, and although used to a considerable extent in that country, has made but little progress here. The thread, instead of passing on to the bobbin through a flyer, as in other throstles, is conducted through a fine metallic loop, mounted so as to revolve upon a ring which projects from the copping rail: this loop is dragged round by the traction of the thread. The bobbin does not in this case rise and fall, to distribute the yarn upon its surface, but the same effect is produced by the upward and downward motion of the ring. This machine exhibits an arrangement of friction surfaces in place of the ordinary driving toothed wheels.

In the French department is exhibited a machine called the "Epurator," the design of which is to supersede the use of the ordinary scutching machine, and effect by one operation the cleaning and carding of the material. When practice has confirmed the use of two distinct processes, it rarely occurs that the final object can be achieved by one; all endeavours, however, to arrive at a simplification of operations should be viewed with consideration. The material to be operated upon by this machine is formed into laps by a spreading apparatus, a number of which laps (five in the exhibited machine) are placed so as to be simultaneously fed by revolving fluted rollers to the cleaning and carding cylinder. This cylinder is four feet in diameter, and revolves at the rate of from 250 to 270 revolutions per minute; its periphery is provided with a series of strips of wire cards with strong teeth, between which strips are placed flexible metallic brushes, the extremities of which project slightly beyond the surface of the cards. The grooved feeding rollers revolve slowly, and therefore present the cotton gradually to the action of the revolving cards and brushes; the effect of which is said to be the combined operation of scutching and carding, the impurities being separated by centrifugal force, and the loosened fibres laid side by side without being broken by the action of revolving beaters. Beneath each pair of feeding rollers there are gratings, through which the separated extraneous matters fall. There are three doffer cylinders to this machine, for the more perfect removal of the cotton; each one of which is provided with the usual doffing combs for the removal of the slivers, which are then guided so as to unite into one. The exhibitor states that this machine will produce from 220 to 260 lbs. of prepared cotton in 12 hours,—one workman superintending two or three machines; and that if coarse numbers are to be spun, a subsequent carding is unnecessary,—the cotton being taken from the Epurator direct to the drawing-frame.

Near the machine last described will be seen a roving-frame of French manufacture, in which the arrangement of wheels for driving the spindles and bobbins is different from that commonly employed in England. Instead of the two shafts, carrying their series of bevil-wheels, one only is employed, which drives a pinion mounted upon a loose collar. On the upper end of this, there is a spur-wheel, which takes into the teeth of two spur pinions, each of which is used for driving a bobbin or spindle, as the case may be.

In the Belgian department a willow is exhibited by the Société du Phœnix, of Ghent. The peculiarity of this machine consists in the employment of a revolving shaft, provided with a series of projecting arms, arranged in a spiral form. This shaft is enclosed within a casing, the internal surface of which is provided with an iron grating. The cotton is fed in through an aperture at one end of the casing, and beaten by the spirally-arranged revolving arms, which, at the same time, carry it forward to be delivered out at the other end,—the separated impurities falling through the surrounding grating.

From Belgium we have also a roving-frame, possessing a feature not entirely new to us, but as yet unemployed. This consists in the employment of series of toothed segments, of decreasing diameter, which constitute conical wheels, and are intended to displace the conical pulleys now ordinarily used; the segments are locked, one after the other, to their shafts, so as to effect the required rotation at the necessary variable speed: this invention is the subject of a patent in England granted to Messrs. Fairbairn and Hetherington.

The Exhibition does not illustrate fully the manufacture of woollen fabrics;—a system of producing woollen yarns is however exhibited by Mr. John Mason, of Rochdale, and claims particular attention. The machinery to which we refer has been for some years in general operation in France and Belgium; but the slowness with which an entire change of system is received in England, has prevented it from becoming as extensively employed as its merit seems to demand. In order that this machinery may be properly understood, we must, in the first place, briefly describe the usual processes employed for the production of woollen yarns, premising that our present notice refers to that branch of the manufacture relating to the class of goods technically distinguished as "woollens," in distinction to "worsteds," comprising broad cloth, flannels, &c., and made from the shorter descriptions of wools.

The material is first cleaned by a machine similar to the willow of the cotton manufacture; and is then subjected to the process of carding, called, in this instance, "scribbling." After this, another carding operation follows,—the wool being doffed therefrom, not in a continuous film, as described in reference to cotton, but in short spongy cords, equal in length to the width of the carding-engine; these "cardings" are then taken to the "billy" (a machine operating on the principle of the mule), where they are joined one to another, generally by hand, so as to form continuous lengths, and twisted previously to being wound into cops, which are to be transferred to the spinning-machine.

According to the system exhibited by Mr. Mason, the wool, as it is taken by the ordinary action of the doffer-comb from the first carding-engine, is gathered into a narrow band, and after passing through a revolving tube, which imparts a certain amount of false twist, is wound upon a roller, so as to constitute a lap, about 16 inches in diameter, and 4 or 5 inches in breadth. When the required quantity is wound on, an arrangement of apparatus, by ringing a bell, gives notice to the attendant; immediately after which, the winding machinery, by a self-acting motion, disengages the lap; so that a determinate quantity of material is always wound upon the roller. Several of these narrow laps are placed, side by side, upon a framework attached to a second carding-engine; and their rollers are mounted so as to be capable of revolving, in order to unwind the carded wool,—which unwinding is effected through the agency of surface-rollers, placed in contact with the lapped material. The slivers, constituting the laps, are applied in such a number, that their aggregate width shall be equal to that of the required feed; and they are conducted through guides, so as to bring their edges together, and thus form a continuous sheet as they are fed into the second carding-engine.

The wool having been carded as usual, is removed by the agency of two doffer-cylinders, each of which has alternate rings of wire-cards and blank places; the rings of cards on the one doffer being opposite to the spaces on the other, and *vice versâ*. By this arrangement, each doffer removes a series of narrow strips of wool, which, being conducted therefrom by stripper-rollers, form endless spongy cords, instead of the short cardings before referred to. These endless cords are then conducted between travelling straps, placed at right angles to the line of progress of the cords, which straps, by their rubbing action, condense the material previously to its being wound upon rollers, and sufficiently to admit of its being taken direct to the spinning-machine.

It will be understood from the foregoing statement, that this system effects a great economy of labor; the feeding being self-acting, and the pieceing and slubbing being dispensed with. This simplification, however, is not the only advantage; the self-feeder supplies the machine in a much more regular manner than can be attained by hand; and the "cardings" are, consequently, more even;—the manufactured threads are also more "nappy," which increases the felting quality in milling, and affords a richness of appearance in the woven cloth not attained in the usual course of manufacture.

In manufacturing warps on this system, it is merely necessary to double the slivers of wool upon an intermediate engine, and draw the slubbing more in the "condenser" and mule, to obtain that straightness of fibre which gives strength to the thread. If the first process of obtaining narrow laps be repeated, so that two carding-engines are fed by a number of these, a doubling, not attainable under the old system, may be effected, which will of course add to the regularity of the yarn. That this system is not universally adopted, may be attributed, in great measure, to the failures which have taken place in other attempts to obtain endless cardings. Mr. Mason's machinery is now however employed by some of the most eminent firms of the north and west of England; and therefore may be looked upon as making its way towards that position which its merit entitles it to attain.

The French department contains an example of an endless carding-engine contributed by Messrs. Merciere & Co., of Louviers; the chief distinction from that we have above described being the employment of series of revolving tubes for consolidating the cardings, instead of the travelling straps of Mr. Mason. In the "first" carding-engine exhibited with this endless carding-engine, the feed-apron is divided into two parts, and the sliver is removed from the doffer in the same number of distinct webs, which pass through separate conical apertures, but are finally united upon the same lap roller. The object of this is to work the machine with different colors of wool, which, becoming mixed at the next operation, afford a party-colored carding. In connection with these machines is also a hand woollen-mule; it does not, however, appear to possess any novelty which demands notice.

MUSICAL INSTRUMENTS.

THE PIANO-FORTE.

The manufacture of piano-fortes forms an important branch of industry in the metropolis. The London Directory for 1851 enumerates nearly 200 piano-forte makers; but it must be explained that all these are not *bonâ fide* manufacturers; many being workmen in some single branch only of the trade; while others are proprietors of music shops, who lend their names to the instruments they sell. In addition to the above, there are also about fifty names of persons under separate branches of the trade, such as piano-forte key makers, hammer and damper cloth makers, hammer rail makers, fret cutters, pin makers, silkers, string makers, and tuners.

We have been unable to discover any published account on which we can rely as to the statistics of the trade in this country; but from enquiries instituted in the best quarters, we are enabled to give the following information, as a tolerable approximation to the truth.

It is estimated that the number of piano-fortes manufactured in London is about 450 per week, or upwards of 23,000 per annum. Some of the largest houses make from 1,500 to 2,500 per annum each, or one-tenth of the whole. Of the annual make, between 5 and 10 per cent. may be estimated of the grand form; about the same of the square; and the remainder, forming by far the largest portion, of the upright form.

The prices of instruments, made by the best houses, in plain mahogany cases, are, for grands, 125 to 135 guineas; for bichord and small grands, 80 to 105 guineas; for grand squares, 50 to 100 guineas; for plain squares, 35 to 50 guineas; for cabinets, 75 to 85 guineas; for cottage and other small uprights, 45 to 70 guineas. These prices are often, however, increased for more expensive cases, in rose or other fancy woods, enriched with ornamental carving or inlaying. Beautiful specimens of such will be found in the Exhibition. Messrs. Collards' principal instrument is valued at 500 guineas; Messrs. Erard's at 1000 guineas; and Messrs. Broadwoods' at probably a higher price still. The enormous money value of these is solely on account of the external decoration;—as musical instruments, they are in no wise superior to the ordinary grands, sold at the prices above named. On the other hand, a class of instruments has been lately introduced by Messrs. Collard, with the laudable object of bringing the price of the ornamental part down to the lowest possible sum; and so putting piano-fortes, of the best make, within the reach of purchasers with limited means. With this view, the most useful variety of the small upright is made in a neat plain case of deal or other cheap wood, and sold for about 30 guineas. The appearance is better than would be supposed from the description: a specimen may be seen in the Exhibition. Low uprights, by small makers, are sold at much less prices than those of the best houses.

Multiplying now the number of instruments by their average price, we may obtain an approximate estimate of the gross annual return in the London trade. In fixing the average prices from those above given, it must be considered, on the one hand, that they should be increased for the number of more expensive cases; on the other, that the prices of many makers, particularly for upright pianos, are less than those of the first-rate houses. Probably the following will not be far from the truth:—

Estimate of piano-fortes annually made in London.

1,500	grands, bichords, and small grands, at, say	£110 each	= £165,000
1,500	squares	60 „	= 90,000
20,000	uprights, of various kinds	35 „	= 700,000
23,000	Total value		£955,000

or nearly a million per annum.

The number of workmen engaged in the piano-forte trade in London may be estimated at between 3000 and 4000. Comparing this with the number of piano-fortes, we find about six or seven instruments made in a year by an amount of labor equivalent to that of one man. In the larger houses, however, where the more expensive kinds are made, the proportion will be less;—say about four or five to a man.

The large quantity of metal work now used in piano-fortes and other musical instruments, employs a separate class of artificers, called music smiths, who furnish to the piano-forte makers all the iron and brass work they require.

The extent of the piano-forte manufacture in France is only about one-third that of England. In 1849 the gross value of the instruments produced was ascertained to be something above 8,000,000 francs, or £320,000.

The German manufacture is probably very large indeed, in consequence of musical education being more generally afforded than in other countries. We have, however, no means of giving any estimate of its amount.

Notwithstanding the great intelligence and care that are brought to bear on the manufacture of piano-fortes, we doubt whether the aid of science has been called in to the extent that could be wished, to guide their construction. Arrangements are often seen, which appear unwarranted by the principles of mechanics; and, generally speaking, the *engineering* of the construction is not so well studied as it ought to be. But, in the application of acoustical science, piano-forte making is yet more behindhand. The theory of the production of tone, at least as regards its quality, is at present wrapt in mystery; few persons seem to have any definite idea what are the essential conditions under which "a good tone" in general, or, still less, any particular quality of tone, can be ensured. A series of tentative experiments leads to certain methods of construction which are considered good; and all possible care is then taken to avoid defects in the manufacture; but the result is, after all, frequently due to some fortuitous combination of circumstances, which cannot be foreseen. Hence arises the variety in the qualities of tone, not only of instruments by different makers of equally good repute, but even in those turned out from the same house, and made apparently in precisely the same manner. Nay, even in the same piano-forte, it frequently happens that the practised ear can detect considerable variations;—sometimes a certain portion of the scale may be far superior to the rest; sometimes a few notes here and there may be deficient in resonance; sometimes one note only in the whole instrument may be faulty; but the reason for these anomalies it is impossible to explain.

The general excellence of a piano-forte depends, however, not only on the design of its various parts, but also on the quality of the materials, and the amount of care bestowed on the workmanship. It is due principally to the great attention paid to these latter points by the chief London houses, that English piano-forte making has obtained, and still retains, its high reputation.

If there is any one point to which, in preference, future attention should more particularly be directed, we think it is the *cheapening* of the better classes of instruments. A hundred and twenty or thirty guineas for a grand is a price altogether beyond the reach of multitudes, who both need and know how to appreciate a good piano. And yet the tendency of late has been rather to increase than diminish the cost. We admit readily, that a piano-forte, made purposely to attain the highest possible grade of perfection, must always bear a high price; but, at the same time, it is but reasonable, that means should be found to bring a class of instrument, equal to the ordinary grand, within the reach of persons by whom it is now quite unattainable. The expediency of combining cheapness with excellence in quality has long been acknowledged and acted upon in almost every other branch of manufacturing art; and indeed seems to be the ruling principle of commerce in the present day. It is beginning, though tardily, to extend itself to the piano-forte manufacture; and we hope, for the sake of the art, that the time may soon come when its influence will be more general.

That this branch of industry is fully represented in the Exhibition, will be seen from the following table, which gives both the number of exhibitors, and of piano-fortes exhibited:—

	Exhibitors.	Piano-fortes exhibited.
Great Britain	38	68
France	21	44
Belgium	6	14
Germany (Zollverein, &c.)	18	24
Austria	5	5
Switzerland	3	3
Denmark	1	2
Russia	1	2
United States	6	9
Canada	2	2
Total	101	173

In our notice of these instruments we shall confine our remarks to explaining, and commenting on, the novelties or peculiarities observed in their construction. We think this course more suited to the object of the present series of papers, than it would be to express opinions on the tone, or on the comparative excellence, or otherwise, of the various specimens exhibited. Such opinions, however just or impartial, might still be open to cavil, and would after all be of little practical utility; while facts, bearing on the construction, must be always interesting and valuable.

Commencing with British exhibitors, we find that Messrs. Addison and Co. have contributed an upright piccolo, called the "Royal Albert transposing piano-forte." The object sought is to transpose vocal music, so as to suit voices whose compass would not allow of their executing it in the original key. For example, if a song be played on the keys as if in C, it can be made to sound either in the key of C sharp, D, E flat, B, B flat, or A,—*i. e.*, in any key within a range of three semitones above or below the original one. There are other contrivances for this purpose in the Exhibition; but in all these, either the key-board and action, or the strings and framing, are shifted laterally, so as to make one hammer strike different strings, according to its position. In the present, neither action nor strings are moveable. The keys may be described as divided at half their length, the front and back ends being capable of moving independently of each other, and the connection being made between them by means of a shifting lever underneath; so that, by altering the position of this lever, the front end of the key C, for example, may be made to act on the back end of either of the keys C sharp, D, B, B flat, &c. A model of the movement accompanies the piano-forte. We cannot see that the present contrivance has much advantage over the other plans; while it is certainly more complicated and expensive, and must inevitably deteriorate the touch. The transposing piano-forte is an old contrivance, having been made by Messrs. Broadwood, under patent, thirty years ago. It has, however, never been much used, and probably never will be. It can only be of service to players of an inferior class; for to better musicians, having a proper perception of pitch, it would be torture to have the fingers playing in one key, while the ears are impressed with another.

Mr. Akerman, of Bridgewater, exhibits an upright cottage, called a "lyric grand," from its back being formed like a lyre; it has three strings to each note, placed obliquely.

An upright piccolo, by Messrs. Robert Allison and Co., has this peculiarity, viz., that the colors of the keys, instead of being arranged in the ordinary progression, are divided in the following manner:—

C	*Grey*
C sharp	White
D	*Grey*
D sharp	White
E	*Grey*
F	White
F sharp	*Grey*
G	White
G sharp	*Grey*
A	White
A sharp	*Grey*
B	White
C	*Grey*

and so on, repeated throughout the instrument. It thus forms what is called a "diapason* scale indicator;" and its use is to indicate to learners the notes necessary to form the diatonic major, or minor scale, in any given key. The rule is, commencing with the key note and ascending:—

To form the major scale, take three successive keys of the same color, and four of the other color.

To form the minor scale, take two keys of the same color, and five of the other.

It is almost needless to add, that this contrivance is more curious than useful, and cannot be intended to apply to piano-fortes generally.

The factory of Messrs. Broadwood and Sons contributes four full-sized grands, 7 octaves, G to G. These have the repetition action, and all the latest improvements. They are all alike, except in the external decoration, and in regard to some few differences in the construction of the metallic bracing. Two of them have three bars parallel with the strings; one has one parallel bar and one placed diagonally; the other has one parallel and two diagonal bars,—the latter lying at different angles. They have all the long transverse bar over the wrest-plank. They are excellent specimens of the grand piano-forte, in its most perfect modern state.

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* Query *diatonic?*

Mr. Cadby exhibits one grand, 7 octaves, C to C, and two cottage uprights, fitted with his "patent suspended and adjustable sound-board." In ordinary instruments, the edges of the sound-board are glued firmly to the framing of the instrument. The patentee considers this has the effect of destroying the brilliancy of the tone, owing to the fact, that the sound-board is not strained tight; he therefore secures it to the framework solely by metal clamps, in such a manner as to admit of its being strained and tightened when desired, like the parchment head of a drum.* In the grand piano-forte exhibited, the framing carrying the strings is separate from the case of the instrument, and may be removed from it entirely.

Messrs. Collard and Collard contribute one grand, 7 octaves, A to A, with all the latest improvements, and one grand square, 6½ octaves, C to G, of a peculiar kind, called by the makers, for distinction, the "square semi-grand." Its peculiarity is, that it has precisely the same action as that used for semi-grands; whereas the ordinary grand square has only an adaptation of the peculiarities of the grand action to that of the common square. A cabinet and two microchordons, or small uprights, 6½ octaves, C to G, are also exhibited. One of the latter is the cheap kind of instrument already alluded to; it has a case of varnished Swiss pine. The whole of these instruments are first class of their respective kinds, and afford favorable examples of the most improved English manufacture.

Messrs. Ennever and Steedman exhibit an upright cottage, 6¾ octaves, C to A, in highly decorated case. The keys (made by Messrs. Brookes) are of pearl and tortoiseshell, instead of ivory and ebony. We think this is a mistake, as the variegated shades must disturb the eye of the player.

A full-sized grand, 7 octaves, A to A, is exhibited by Messrs Erard; the peculiarity of which is, that in addition to the metallic string-plate and longitudinal tension-bars, the wrest-block is also of metal, being formed of a framework of brass, in which is fixed a strip of beech wood to receive the wrest-pins. This, in conjunction with the longitudinal bars and the string-plate, form an entire metallic framing, extending from one end of the instrument to the other. Entire frames of metal have previously been used for upright instruments, and grands and squares, with entire metallic frames, are exhibited by American and Danish manufacturers; Messrs. Erard have, however, a patent for their peculiar method of application. We are inclined to fear that there is a growing tendency to use too much metal in the construction of piano-fortes. Up to a certain point it may, no doubt, be very valuable for its strength-giving powers; but there will probably be found a limit beyond which it may be injurious to the quality of the tone; it undoubtedly would be so if used to any extent in the violin tribe, whose resonance is produced in a way very analogous to that of the piano-forte. It must be considered also that so much metal adds greatly to the weight and the cost of the instrument, and diminishes proportionately its portability and general usefulness.

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* For specification of this invention see p. 319, Vol. XXXVIII. of Lon. Jour.

Another full-sized grand, by the same house, 7 octaves, A to A, has a pedal clavier, similar to that of an organ. The pedal notes act on the lower notes of the piano, and have a compass of about two octaves. This is not new, as organ builders and organ players have frequently adapted pedals to piano-fortes; and, some years ago, Messrs. Coventry and Hollier, of Dean-street, Soho, sold piano-fortes with pedals attached. We must say, however, that Messrs. Erard's adaptation is superior to any former ones we have seen. Many of our readers probably know, that the attainment of proficiency in organ playing requires great practice with the pedal clavier; and, since practising at churches is very inconvenient, it is obvious that an arrangement of piano-forte pedals for the chamber would be of service to organists; but if, as we understand, the cost of the addition, as made by Messrs. Erard, amounts to nearly 30 or 40 per cent. extra on the price of the piano, we fear its use will be much circumscribed.

A small upright, 7 octaves, A to A, by Messrs. Erard, differs in many respects from the ordinary English construction. In the first place, it has three strings to each note; whereas most English pianos of this kind have only two. Secondly, the strings, instead of being placed vertically, run obliquely across the instrument, by which a greater length is gained without increasing the height of the case.* Thirdly, it has a metallic bracing in front of the sound-board, on the same principle as that applied to the grand form. Fourthly, it is provided with a new repetition action, lately patented by this firm. Fifthly, it has a soft pedal acting in a peculiar way. The ordinary method of producing the soft tone in grands and uprights, is by shifting the action, so that the hammers strike only two strings instead of three, or one instead of two. Now this is inconvenient to accomplish where the strings run obliquely; and therefore the soft effect is here produced by interposing a piece of soft cloth between the hammer and the string, which deadens or softens the blow. It is an old French invention, and was originally called the *"jeu céleste;"*—its effect is pleasing; and it avoids the tendency to throw the piano-forte out of tune, which is often the result of giving the blow to one string.

This firm also exhibit a peculiar method proposed for the attachment of the tuning end of the string. In this, the ordinary wrest-pin is omitted, and replaced by a nut or female screw, to which the end of the string is attached, and in which a fixed screw works. By applying the tuning key to turn this fixed screw, the nut attached to the string may be drawn or relaxed (according to the direction in which the tuning key is turned), and the pitch raised or lowered at pleasure. This plan is by no means new; it was adopted by a Mr. Lewis about a quarter of a century ago; and we have seen drawings and models of his instruments, shewing the arrangement precisely as now revived by Messrs. Erard. The evils of the ordinary wrest-pins are stated to be, that they require considerable force to turn, and become in time liable to slacken and let the piano-forte go out of tune. These are not of so much weight as is generally supposed; the latter objection, however, increases in importance, as the strings are made thicker, and the tension is consequently greater; and this is further enhanced by the heavier blows given in modern piano-forte playing. The ordinary friction wrest-pin is, it must be confessed, a primitive contrivance; but its extreme simplicity has retained it in use. If a firmer method, equally simple, could be devised, it would doubtless be an improvement; but we do not think the plan exhibited by Messrs. Erard is the most advisable. There are other modes to be seen in the Exhibition for attaining the same object; and we shall notice them in due course.

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* This is a very old plan, having been patented by Mr. Wornum about 1810. The piano, thus made, was called the "unique," and was the first low variety of the upright form. Several hundreds were made by the firm of Wilkinson and Wornum.

A horizontal piano-forte, by Mr. Greiner, termed, we suppose, a bi-chord grand, but which is in reality unlike any instrument hitherto made, calls for special remark. Its strings lie in two planes, slightly inclined to the horizontal, and to each other, and intersecting at the front end of the instrument; their farther ends opening out into something like the shape of a trumpet. The idea of the inventor is, that this shape will throw the sound out horizontally, and make the instrument better heard than on the ordinary plan; but we cannot think that any advantage of this kind will compensate for the awkwardness of the form, and the difficulties attending its manufacture. A second novelty in this instrument is what the inventor calls the unison method of tuning. One wire forms the two strings of each note; it is looped at its two ends to two adjoining pins in the string-plate at the back of the instrument, and its centre is turned over a cylindrical stud at the front. This front stud is capable of being moved backwards and forwards by a screw, by which the two halves of the wire are tuned simultaneously. In order to adjust the two strings to a unison, the front cylindrical stud is moveable round its centre by means of a lever, which gives the power of tightening one half of the wire and slackening the other, until a perfect unison is obtained: of course this method of stringing is not applicable where three strings are used. A third novelty is in the action, called a repeating check. It is a means of producing the repeating power by a small tongue of leather attached to the check, and jointed, so as to move upwards with perfect ease, but to offer resistance to motion in the contrary direction. By this arrangement the hammer is allowed to rise without obstruction; but when it tends to fall, it is held up by the leather tongue till the hopper engages, and thus the repetition is secured. This is one of the simplest contrivances for the purpose we have seen. Mr. Greiner also exhibits a model of a new method of stringing, by which two strings are made to vibrate by a blow given to one only, on the same principle as the synchronous vibrations of the two arms of a tuning fork.

Messrs. Harrison & Co. exhibit an upright piccolo, called the "utilitarian boudoir piano," and made with the object of constructing a piano-forte at the least possible cost: the price of this instrument being eighteen guineas only. To effect this, several alteration shave been made. In the first place, there is only one string to each note; secondly, the before the strings, and therefore to offer less obstruction to the passage of the sound.

Mr. Mott exhibits a grand, 7½ octaves, F to C, with a seraphine of 5 octaves applied thereto under the front part of the instrument, and thus forming two claviers. A solo may be performed on one of them, and an accompaniment on the other; or, by means of couplers, they may both be played together.

A grand, 6¾ octaves, C to A, by Messrs. Stodart, is a very interesting specimen, inasmuch as it is fitted with metallic bracing, on the plan patented by Mr. Stodart in 1820. This is the original of all the varieties of metallic bearing now in use, and its leading features—viz., a metallic string-plate kept apart from the wrest-plank by a system of longitudinal metallic bars—are essentially the same as have ever since been followed. The only variations from the more modern systems in matters of detail are, that the longitudinal stretchers are hollow tubes instead of flat bars, and that the string-plate is detached from the wood framing below. With regard to the form of the stretcher, there is no doubt the hollow tube is the more correct form, on mechanical principles, as being better calculated to offer the greatest resistance to a compressive force with the least quantity of material. Every one acquainted with constructive science knows that a hollow tube is the most advantageous form for a column, and the function of the metallic stretchers in a piano-forte is precisely analogous. The object of leaving the string-plate detached from the woodwork below, was to allow the whole metallic frame, with the strings it carried, to contract and expand together, under atmospheric changes, without straining the woodwork, since wood and metal are, it is well known, differently influenced in this respect. The experience of other makers has not shewn this to be of much importance in practice; and therefore the separation of the wood and metal framing is but seldom adhered to; but the idea is ingenious, and the principle correct. Altogether Mr. Stodart's system of metallic framing, adopted at such an early date, is a good example of the application of scientific knowledge to the construction of the piano-forte; and the very general way in which it has been since followed, corroborates the universal rule that improvements, based on correct principles, are those which will ultimately be found of the greatest practical value. A peculiarity in the framing of this piano-forte, although not a part of the original system, is that the wrest-plank is turned upside down, being placed above the strings instead of below them; by this arrangement, the strings are struck against their rests, without the necessity for an upward bearing stud; while the metallic stretcher-bars bear directly against the plank instead of being cranked down to it, as in the common plan. The wrest-pins pass completely through the plank, and their squared ends appear above it, so to offer facility for tuning. The inverted wrest-plank is a remnant of a system introduced by Mr. Wornum, in which the entire wood framing was placed above the strings; but which, from its inconvenience, has not continued in use.

The same firm also exhibit a square, 6¾ octaves, C to A, with a down-striking action. This example shews satisfactorily how much the framing of the square piano-forte might be simplified and improved by the substitution of the inverted mechanism. The action has an improvement by Mr. Greiner, by which the necessity for springs is done away We believe that Mr. Stodart introduced the down-striking square four or five years ago, and is the only English maker who has manufactured instruments on this principle. This piano is six or eight inches shorter than ordinary squares; wherefore the maker has called it the "compact square." Moreover the key-board is in the middle of the length; and the appearance is therefore symmetrical. This has also been done by Messrs. Collards.

A bichord grand, made by Messrs. Towns and Packer, has the power of transposing through a range of four semitones above or below the original key. It has, for this purpose, an arrangement for shifting the key-board and action in a lateral direction. This is the original way in which the transposing piano-forte was made.*

Mr. Woolley, of Nottingham, exhibits two piccolo uprights, 7 octaves, C to C. These have three vertical strings to each note, and have a bracing behind the frame, called the "patent equilibrium," for taking the tension of the strings.

Mr. Wornum contributes a small bichord grand, called the "Albion" grand. The peculiarity of this instrument is, that it has a down-striking action, patented by the maker in 1842. There is no metallic bracing to this piano, and it affords a good example of how much the introduction of the down-striking principle would simplify and cheapen the instruments of this form, as Mr. Stodart's does in reference to the square. A piccolo upright, 6¾ octaves, C to A, by the same maker, is a good specimen of the first form of low upright, with vertical of necessity, lie at some distance from the front end of the instrument; while in M. Pape's arrangement the string is brought completely up to the front, and thus an increase of about a foot in length is obtained, or, which is the same thing, an equal diminution in the length of the instrument for the same length of string.

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* Vide remarks on Mr. Addison's piano-forte, *ante*.

M. Pape states, that the principal inducement which lead him to adopt the down-striking action was to avoid the opening for the hammers, and so to simplify the construction of the sound-board and framing,—parts so important to the tone and durability; they are, accordingly, continuous and unbroken throughout their whole extent, as in an upright instrument. There are, however, other important novelties in their arrangement. In the ordinary construction of pianos, of whatever form, the sound-board is glued firmly to the framing, on the same side of it as the strings, and immediately below them. Now, a little consideration will shew that the pull of the strings has a constant tendency to compress the sound-board; an effect which, when existing to any great extent, must inevitably deteriorate the tone. There is little doubt that the derangement of the sound-board, by the constant tension of the strings, is the principal reason why piano-fortes have generally lost their tone as they have become older; for we know, by the analogy of the violin, that, supposing all the parts to remain undisturbed, the effect of age ought rather to improve than to deteriorate* instruments depending on wood for their sonority. M. Pape gets rid of the evil above named, by placing the sound-board on the opposite side of the framing to that occupied by the strings. A strong open frame of cast-iron, or wood strengthened with iron, extends over the whole size of the instrument, forming the bottom of the piano; on the upper side of this the strings are stretched, and on the lower side is fixed the sound-board; by which arrangement the pull of the strings can have no tendency to compress the sound-board; but if any action at all is produced on it, it must be that of extension, which is beneficial rather than otherwise. The bridge, over which the strings pass (and which, in the ordinary construction, is glued upon the sound-board), is, in the new arrangement, a loose piece, communicating with the sound-board by sound-pegs, similar to that of a violin, which transmit the vibrations to the sound-board exactly in an analogous manner. Another advantage is obtained by this arrangement, viz., that the sound-board may be considerably enlarged. In the ordinary construction its size is bounded by the blocks and points of attachment of the strings to the framing; whereas, in this plan, no such limitation being necessary, the sound-board may extend over the whole surface of the instrument, by which increase of dimensions a proportionately greater resonance is obtained. This is of especial value in the small upright forms. Another alteration in the sound-board is in the position of the strengthening ribs; these are usually fixed on the side opposite to the strings; M. Pape places them towards the strings, in which position he considers them much more favorably placed, inasmuch as the strain tends to fix them more firmly instead of to loosen their ends, as on the ordinary plan. The sound-board is also made thicker and more solid than usual. M. Pape occasionally makes grands of the compass of 8 octaves, F to F; for these the new arrangement of sound-board gives the means of obtaining the requisite length for the lower notes, without increasing the size of the case beyond that of an ordinary grand.

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* It is worthy of consideration, however, that it is scarcely possible to compare the present tone of an old piano with what it originally was. To try it against a new piano is not fair; for as improvements are constantly being made, the quality of a new instrument must necessarily be superior to that of one made several years before. Hence, a piano-forte that retains its tone perfectly, might, by this criterion, be unjustly charged with deterioration.

The square, as made by M. Pape, has a down-striking action, and the same arrangement of sound-board as above described.

The table piano is an instrument having the size and appearance of an ordinary drawing-room table; one end being lifted up, the keys slide out in a sort of drawer, and the table is converted at once into a piano-forte. The action is down-striking like the grand, and the hammers are directly under the front end of the keys; the strings are brought up to the front, and cross each other in two different planes, by which the necessary length for the lower notes is obtained. The sounding-board extends over the whole instrument; and it is only by M. Pape's plan that sounding-boards of sufficient extent, and strings of sufficient length, to yield any tolerable tone, could be given to this small size of instrument. A table piano, of 6½ octaves, measures, on the top, only about 4 feet square.

The console upright is the smallest, the most elegant in shape, and the most effective for its size, of any of the vertical class of instruments we have seen. It has the appearance of a chiffonier, and stands little more than three feet high,—the

Erard's action.* Nearly all the uprights have three strings to a note, sometimes placed obliquely. Some are on the transposing plan. The Belgian pianos have a general resemblance to those of French make.

Austria exhibits four grand and one upright piano-fortes, by five different makers.

A seven-octave grand, by Hoxa, Vienna, has a peculiarity in that the string-plate consists of separated strips of thin metal, united to one plate at the back, something like a comb,—the front or loose ends of the strips carrying each three or four strings. The object of this is, we presume, to avoid cross strains in the plate, and to throw the whole tension directly on the back end, when it is united to the frame. In other respects all the grands are nearly alike. The framing seems to be on the usual plan, with metallic bars, but the upward bearing is not used. The action is altogether different from the English mechanism; the hammer is reversed in position, having its head turned towards the front of the instrument, instead of towards the back, as with us. The movement from the key is given therefore to the back end of the hammer. The check is a fixture in front of the hammer-head, and the escapement has a singular action, which throws the hammer forward against the check at the time it falls. There appears to be no contrivance for repetition. The dampers for the lower half of the instrument consist of wedges of soft cloth, entering between the strings, instead of flat surfaces simply dropping upon them.

M. Seuffert, Vienna, exhibits an upright in a very handsome case, with three vertical strings to each note. The dampers are placed behind the strings, *i.e.*, between them and the sound-board; an arrangement which gives the power of damping below the striking point, whereby the vibration is more effectually stopped; the bass dampers are on the wedge principle. The action is peculiar.

Germany (the Zollverein, &c.,) sends an assortment of instruments of all shapes. Some of the grands are copies of those of Erard.

M. Bessalié, Breslau, exhibits a grand, with a new method of tuning: the end of each string is looped to an iron screw, which projects through a hole in a fixed plate, running across the whole width of the instrument over the wrest-plank; the screw is tightened up by a nut bearing against the front of this fixed plate, and turned by a key. The plan is something like Lewis's (*vide* Erard), but simpler, and it also simplifies the bracing. There is a difficulty in preventing the screw from turning with the nut, which is overcome in this specimen in rather a clumsy manner. The instrument has an action something like Collard's, and the Austrian wedge damper.

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* In page 426, Vol. xxxviii., it is stated that no other maker has adopted Erard's action. It should be no *English* maker. The mechanism referred to has been extensively copied on the continent.

A square by Dörner, Stuttgart, has a new kind of damper, consisting of a lever, placed horizontally over the strings and parallel to the keys. The fulcrum is in front; the back end of the lever is lifted by a wire rising between the strings behind the bridge; and the damping-cloth is fixed on the middle of the lever, between the back end and the fulcrum. The advantages of this damper are analogous to those of Collard's long-headed one, viz., placing the rising wire out of reach of the vibrating string, and bringing the damping point as far along the string as possible. This instrument has three strings to the upper notes.

A square, by Heitemeyer, Münster, is on a new construction: it has an action like the Austrian, giving the blow at the front of the instrument, instead of at the back. The strings are crossed, and the upper half has three wires to a note. There are a number of strings at the back of the instrument tuned to a unison, but not intended to be played upon by the keys; the object of this addition we could not learn.

A cottage upright, by Rühms, Altona, has a framing of cast-iron, with a sound-board on each side.

Denmark.—A grand and a square, by Hornung, Copenhagen, has the wrest-block, wrest-plank, longitudinal-stretchers, and string-plate, cast in one piece of iron, on the American plan. The stretchers are not straight bars, but consist of ornamental scroll work. The instruments have the English action. The square has the upward bearing;—a novelty, we believe, in pianos of this form.

Russia.—In two grands, by Lichtenthal, St. Petersburg, the bass strings, to the extent of about 2 octaves, are placed at a higher level than those of the other part, and cross them obliquely, which gives the opportunity of curving that side of the instrument which is ordinarily made a straight line. We cannot see, however, that the shape, as exemplified in these pianos, is at all improved thereby; while the construction is much more complicated, and therefore inferior. Moreover, strains acting obliquely in different directions, act irregularly on the framing, render it difficult to brace, and tend to throw the instrument out of tune. The action is on the English plan.

illegible. By Messrs. Church and Goddard's machine for printing, numbering, cutting, counting, and packing railway tickets, this difficulty also is removed, and great speed is attained in manufacturing the tickets, as the several operations which we have enumerated are simultaneously performed. Pasteboard cut into strips by means of rollers, as above explained, is fed into the machine by being laid in a trough and brought under the prongs of a fork (working with an intermitting movement), which pushes the strips successively forward between the first pair of a series of guide or carrying rollers. There are four pairs of rollers, placed so as to conduct the strip through the machine in a horizontal line; and an intermittent movement is given them for the purpose of carrying the strip forward a short distance at intervals. The standards of the machine carry, at the top, a block, termed the "platten," as it acts the part of the press-head in the common printing-machine,—portions of it projecting downwards, between the upper rollers of the first and second, and second and third, pairs of carrying-rollers, nearly to the horizontal plane in which the pasteboard lies, so as to sustain it at those points while it receives the pressure of the printing types and numbering discs, hereafter referred to. The types, to designate the nature of the ticket, as "Birmingham, First Class," are secured in a "chase" upon a metal plate or table, which also carries the numbering discs for imprinting the figures upon the cards; and this table, by a cam-action, is alternately raised, to bring the types and numbering discs in contact with the pasteboard, and then lowered into a suitable position to admit of an inking-roller moving over the types and numbering discs, and applying ink thereto. The table likewise carries, at one end, a knife, which acts in conjunction with a knife-edge, projecting downwards from the fixed head of the machine, and thereby gives the cross-cut to the strips between the third and fourth pairs of carrying-rollers;—thus severing each into a given number of tickets. The strip of pasteboard, which is fed into the machine, stops on arriving at the second pair of carrying-rollers; and, on the ascent of the printing-table, the types print on that portion which is between the first and second pairs of rollers. The strip then passes on to the third pair of rollers, where it stops; and, on the table again ascending, the numbering discs imprint the proper number upon the pasteboard between the second and third pairs;—the type, in the mean while, printing what is to be the next following ticket. On the next ascent of the table, the strip has advanced to the fourth pair of rollers; and the knives being now brought into contact, the printed and numbered portion of the strip is severed. The now completed ticket is lastly delivered by the fourth pair of rollers into a hollow guide-piece, and conducted to a box below, provided with a piston, which, to facilitate the packing of the tickets in the box, can be adjusted to any height to receive the tickets as they fall. To avoid the necessity of having to count the tickets after they are taken from the receiving-box, a counting apparatus, connected with the working parts of the machine, is made to strike a bell on the completion of every hundred or more tickets, so as to warn the attendant to remove them from the box. The inking apparatus assimilates in character to self-acting inkers in ordinary printing presses; and the numbering discs are worked in a manner very similar to those described in the last paper for paging books.

A simple arrangement of apparatus for printing and numbering cards is exhibited by Messrs. Harrild & Sons. The types are fixed in a metal frame, which also carries the numbering discs. This frame is mounted on a rocking-shaft, and is furnished with a handle, whereby it is rocked to bring down the types and discs upon the card, to produce the impression. When the frame is raised again, the units disc is moved forward one figure, and the types are inked by a small roller, which takes its supply of ink from an inking table that forms the top of the frame. This is a useful description of machine; but the specimen in the Exhibition does not appear to be properly adjusted, as the figures of the numbering discs have a tendency to cut through the card.

M. Baranowski, of Paris, exhibits a machine for printing and numbering tickets, and also indicating the number printed. The types and numbering discs are carried by a horizontal rotating shaft, upon which, near each end thereof, is a metal disc; and upon the periphery of these discs a metal frame is affixed, which carries the types and numbering discs, and corresponds in curvature with the edge of the discs. The types, for printing the inscription upon the ticket, are arranged at right angles to the length of the shaft, which position admits of some lines of the inscription being printed in one color and the remainder in another color. In the type-frame a slot or opening is formed, lengthwise of the shaft; and behind this opening are three numbering discs, and three discs for indicating the quantity of tickets numbered,—all standing in the same row. The numbering discs are made with raised figures, which project through the slot in order to print the number handle of the lever and the axis thereof,—such lever being furnished at the other end, beyond its axis, with a counterbalance weight. A thin and narrow blade of metal, about two inches long, projects downwards from the side of the piston, but for what purpose is not very apparent. The bottle is placed on a small wooden disc, carried by an upright rod, connected with a treadle below, by depressing which the bottle is raised to the conical tube.

A third machine for corking bottles is contributed by M. A. De Montebello, of Mareuil sur Aï, Champagne, France. In this machine, the conical channel, through which the cork is forced into the neck of the bottle, consists of a pair of dies, which are opened and closed by a horizontal sliding-piece, having two curved or divergent grooves in the upper surface thereof to receive two pins, one from each die; and such sliding-piece is moved to and fro, by means of a small hand lever. When the sliding-piece is in its nearest position to the dies, the pins are in those parts of the curves which are closest together, and the dies are closed; but when the sliding-piece recedes from the dies, the pins are gradually moved further away from each other by the divergence of the curves, and the dies are opened. The bottle is raised so as to bring its mouth up to the opening in the bottom of the dies, by means of a weighted lever, and the cork is forced into the bottle by the descent of an iron pin or rod; the iron pin is raised again by pressing upon a treadle; the sliding-piece is then drawn back, by means of the hand lever, so as to open the dies to receive another cork; and, as the sliding-piece is connected by two strings or cords (passing over pulleys), with the weighted lever that raises the bottle, such movement of the sliding-piece will elevate the weighted end of the lever, and permit of the descent of the bottle.

M. Bonardel, of Berlin, exhibits an ingenious machine for cutting corks, which is stated to be capable of producing about 1500 corks per day. The piece of cork to be shaped is held between a pair of small metal discs, having serrated faces (in order to hold it more securely), and corresponding in diameter with the two ends of the finished cork. In front of the cork a straight knife works to and fro, taking a slice off the cork at each movement; and it is so connected by mechanism with the discs, that, for every movement which it makes, the discs and cork will turn partly round, so as to present a fresh surface for the knife to act upon. The cork is held in such a position by the discs, that a line passing through its centre, and through the centre of the discs, will not be parallel to the direction in which the knife moves, but form an angle therewith; and thus the knife will cut the cork into the tapering or conical shape, which they ordinarily assume, and thereby remove all the portions of cork which projected beyond the edges of the discs when first placed in the machine.

In contrivances applicable to domestic economy, the Exhibition does not appear to be rife. Amongst the few of this class of labor-saving machines, we notice a simple apparatus by Mr. Weatherley, for cleaning dried currants, designed to supersede the ordinary operation of rubbing the currants with the hands over a sieve. It consists of a horizontal octagonal drum or case, supported by legs,—its lower half being formed of wire gauze, with meshes of a suitable size, to prevent the currants falling through, and its upper half of wood, with a hinged door, through which the currants are introduced. In the centre of the case is a horizontal cylinder, provided with numerous strips of whalebone, projecting radially therefrom, and forming a kind of brush, which revolves in contact with the inner surface of the case; the axis of this cylindrical brush projects through the ends of the case, and turns in suitable bearings by means of a winch-handle affixed to the axis. The rotating-brush rubs the currants over the wire-gauze bottom of the case, and forces the refuse through the meshes into a tray below.

A machine for cutting loaf sugar is exhibited by Mr. S. Sharp, of Stamford. Two knives are situated one above the other in the same vertical plane,—the lower knife being fixed to the framing of the machine, and the upper one having an up-and-down motion through the action of a treadle, it being guided in its movements by upright rods, which extend through an opening in an ear or lug at each end of the knife. Each knife is formed with a cross blade near one end thereof, and a second lateral blade at one side only of the knife. The loaf of sugar is first divided into three pieces by the main cutting-edges of the knives; and these pieces are again divided by the second lateral blades into pieces of proper size to make four lumps; then, by putting these lumps under the cross blade and depressing the top knife, they are quickly divided into four pieces.

Messrs. Barrett, Exall, and Andrews, of Reading, exhibit some machinery for making small fancy biscuits. The flour, water, and other materials for making the dough, are first put into a horizontal metal pan, which rotates, and carries the mixture beneath a stationary corrugated metal cylinder as often as may be deemed requisite in order to prepare the dough. It is next passed between a pair of smooth metal rollers, which exert a kneading or pressing action upon it. After this, the dough is caused to pass between several endless travelling cloths (distended over rollers), which complete the preparation. It is then transferred in the form of a sheet to an endless travelling cloth, having an intermitting movement, which carries it beneath an apparatus, whereby the biscuits are moulded, pierced, and stamped out. The continued progress of the endless cloth brings a fresh supply of dough beneath the stamping apparatus, and allows of the biscuits already formed to be removed from the cloth to the oven. The edges of the dough, before passing beneath the stamping apparatus, are cut square by a pair of metal discs or circular cutters, one at each side of the table, along which the dough is conveyed by the endless cloth. The stamping apparatus may be briefly described as consisting of several dies or moulds which are combined so as to move together, and are partly enclosed in and kept separate by a metal frame, also moveable, and furnished at its under side with cutting-edges to divide the dough. The stamps first descend and impress the dough with the desired patterns; and the metal frame then follows and separates the several biscuits, at the same time piercing holes in them by means of small pins projecting therefrom. The dies and the frame now ascend, and leave the biscuits on the endless cloth; but in case they should stick to the dies a means is provided for drawing up the dies into their metal frame, and thereby throwing off the biscuit.

A simple but apparently efficient apparatus for mixing and kneading dough by mechanical means in place of manual labor, also claims attention. This is contained in the French department, and is the contribution of M. Boland, of Paris. It consists of a semi-cylindrical metal trough, at the upper part of which there is a horizontal shaft, extending from one end to the other, and carrying a set of curved metal bars, arranged so as to form two portions of an Archimedean screw. The shaft turns partly round in either direction, alternately, and thus the screw-blades are caused to work the mixture of flour, water, and other matters, to and fro in the trough, until the operation of mixing and kneading is completed.

DECORATIVE ART.

In pursuance of our intention of taking successively different branches of art-manufacture to illustrate our remarks upon decorative art, we this month propose to devote some space to considerations connected with the manufacture of porcelain and pottery ware.

The term porcelain applies only to the finer kinds of earthenware; and that so well known as the production of the Chinese may be looked upon as the original type of this manufacture. The art of making porcelain is one of great antiquity; but when, where, or by whom invented, is a matter lost in the obscurity of ages. In one form or another, porcelain seems to have been well known to all the ancients. In China, Siam, Japan, Persia, and some other Eastern countries, it has been known at least throughout the historic period; but even the annals of the Chinese empire, notwithstanding their great antiquity, are said to be silent as to the origin of this invention. It is thought by some writers that the celebrated and costly Vasa Murrhina of the Romans, although generally supposed to be formed out of a natural spar-like substance, similar to fluor spar, were in reality a kind of porcelain. Although the origin of this art is thus uncertain, it is known that at a comparatively early period, it was an established branch of manufacture in the hands of the Chinese; records serving to shew that, about the fourth century of the Christian era, porcelain was manufactured in China, although its use was prohibited to any beyond the Emperor's household.

The secret of making porcelain long remained with the Chinese, but the nature of the process was discovered about 1706 by Böttcher, a native of Dresden, and afterwards published by Reaumur and others. It is to the researches of Reaumur indeed that a true conception of the nature of porcelain is due; and it may be said that the perfection of French porcelain at the present time is owing, in most part, to his labors. The first European porcelain manufactories were in Saxony; and even up to the present day, the porcelain produced in that country alone (in point of texture) approaches closely to the porcelain of China. In the finest kinds of porcelain, infusibility is a remarkable and valuable characteristic, the beauty of the material and the brilliancy of the colors employed in its decoration depending in great measure upon this; broadly, this character serves to distinguish porcelain as of two kinds —hard or refractory porcelain, and tender porcelain. The celebrated Chinese fabric is of the former; so also is that of be seen in a very fine Dresden vase, in one of the departments of the Zolverein, at the Exhibition. In this a chain of dancing figures surrounds the upper part of the vase, serving to form a most elegant decoration, which is made the vehicle of both color and form at the same time.

The second reason for the non-employment of pictures may be found in the shape and character of works in porcelain. Being almost always circular, or at least taking some modification of rounded figures, they require that the pattern should be well distributed, that a certain balance should be kept up between the parts. This shews us why repetition patterns produce a better and more agreeable effect than even the most admissible kind of pictorial ornament, viz., wreaths of flowers. The vase just mentioned—which in form is a copy from the antique—is a beautiful example of the effect which may be produced by continuous patterns, for the function of the troop of figures at the upper part is that of a repetition pattern, and not of a picture.

Excess of ornament is the most prominent vice in many kinds of porcelain, the surface being so laden with gold and figures, that the material of the work is entirely hidden. As an example of this, we refer to the, in other respects, very fine vase, at the entrance of the Russian department. The ornament of this vase, viewed alone, is beautifully executed; and the painting, after Robert, we believe, must be looked upon as a work of great merit,—perhaps one of the most successful specimens of painting upon porcelain; but the excess of gilding serves to detract from the artistic excellence of the work,—producing a gaudy meretricious effect. In the department of the Zollverein there is another very fine Dresden vase, of quaint form, also copied from the antique, in which the centre part is ornamented with a continuous composition landscape, finely painted: this gives the effect of a band of harmonizing colors, and although open to the objection which must always attend the introduction of pictures of this class, it is, perhaps, the best form in which a picture could be introduced.

Near the Dresden porcelain—in a recess—the visitor to the Exhibition will find some fine specimens of porcelain from the royal manufactory of Meissen, near Dresden. Two very large vases are in this collection, and they may, we presume, be considered excellent specimens of the fabric. With respect to form and kind of ornament, these works are in many points defective; but as examples of porcelain manufacture, we believe they would bear comparison with the best Chinese porcelain.

In the French department we meet with some fine Sevres vases, and here the defect of over-ornamentation becomes most glaring. Two tall vases may be remarked here, of uniform tint, covered with butterflies and other winged insects, which are arranged with fine taste. In these, although the ornament is singular in character, and of questionable fitness, we have a good example of the advantages of a distributive pattern. To those who believe that porcelain is an imperfect vehicle for painting, we should recommend a visit to this department. The beauty of the colors, the effect of light and shade, the sharpness of the touch, are all as perfect as they could be rendered on canvass. We have evidence, then, beyond question, that the unsuitableness of pictures to porcelain ornamentation arises, not from the impossibility of executing the most finished and effective works, but from such works being out of place when applied to a rounded or convex surface; or to objects intended to be used for purposes incompatible with pictorial decoration.

Although in the highest class of porcelain manufacture —that is in the production of purely ornamental objects, in which the art of design bears an important relation to the merely technical work—we are generally surpassed by some of the continental manufactories, there is a branch of the same art in which we certainly equal, if not excel, them; this is in the manufacture of porcelain for the purposes of the table. In the north gallery of the Great Exhibition the connoisseur of English porcelain will find a collection of every variety of this fabric; a collection so extensive indeed as to present a complete picture of the present state of the manufacture in England. It would be folly to assert that this equals the French or Saxon porcelain, either in the texture or durability of the material of which it is formed, but it is generally equal to them in color, and in the shape and character of the objects. The porcelain itself is of a different class,—its chief peculiarity being its incapability of sustaining the high temperature which is necessary to develope the colors in the most perfect manner. But notwithstanding the difficulties against which English manufacturers have had to contend in the inferior character of their material, they have been successful in producing color upon it, which, in many instances, is as good as that of the continental china. There are numerous examples of this fact in the Exhibition, but the want of references to individual objects in the catalogue, prevents our pointing out particular specimens. What is called the Rose Dubarry dessert-service, by Daniell, is, however, so prominent, that it may be easily found; and it affords an excellent illustration of the perfection of color reached by English manufactures. It is unfortunate that the efforts of the artists and designers have not been equally successful. The truth is, that in the decoration of table porcelain, as in that of other kinds, a mistaken principle seems to have guided the manufacturer: his attempts are always, more or less, in one direction—the elaborate ornamentation of his works with pictures. It would be unjust to deny, that so far as the painting of the china is concerned, some beautiful effects have been produced,—witness the porcelain panels and other works exhibited by Copeland; but the system of putting landscapes and flowers upon dishes is one quite irrational, and very often absurd. A plate or a soup-tureen is not a proper vehicle for pictorial representations, nor are these compatible with the uses to which such articles are applied; and we deprecate the principle of the employment of pictures in such a case even more strongly than in the decoration of a vase, which is intended to be purely ornamental. The adoption of arabesque or geometrical patterns,—mere combinations of forms, not intended to convey any particular idea to the mind, but possessing the capability of producing an harmonious impression, and of affording a good medium for color,—is the true principle of ornament for works of this class. These remarks apply to jugs, as well as to other articles for table use; but here the manufacturer possesses a great advantage, if he chooses to avail himself of it; the form of a plate or dish, or even of a tureen, admits however of little variation: they are intended to perform certain duties, and their shapes are limited accordingly; whereas, in designing a jug, the taste and artistic skill of the maker is free to exercise itself, and there are few objects more capable of bearing the impress of that taste and skill. To obtain the best forms of jugs we must, however, return to ancient art; and this circumstance seems to furnish another proof that the ancients employed some universal and apparently infallible rule in obtaining the forms which so admirably distinguish, not only their ceramic works, but their decoration generally. The cases of Copeland, Minton, Ridgway, Meigh, &c., contain the best specimens of English porcelain; we must not forget also to direct attention to a small tea service by Pellatt.

In Class 25, of the Exhibition, are displayed some flower vases and other articles in imitation of the celebrated majolica ware. This fabric possessed a peculiar character; it was not porcelain, but a common earthenware; and what served to distinguish it, was the circumstance of its being coated with a fine opaque glaze, which possessed sufficient body to cover and entirely conceal the coarse ware which formed the foundation of the work. This kind of ware was originally made either in Spain or Italy;—in the latter country it attained perfection at an early period; and it is said, that the skill of the greatest masters of the age was not thought to be unworthily employed in the painting and decoration of these majolica vases;—and so much art was bestowed upon them, both in their manufacture and decoration, that the few remains of the fabric extant are estimated at the most extravagant rate. The specimens of the revived majolica in the Exhibition are by Minton; but the style of art in which they are executed does not deserve commendation.

In the same department, and exhibited also by Minton, are specimens of encaustic tiles, for walls and flooring. In these the efforts of the manufacturer have been in the right direction. A correct principle has been adopted. These tiles are intended to imitate the tesselated pavements of the ancients; and the designs which have been executed upon them appear to us to possess, in a remarkable degree, the attribute of fitness to their object. The remarks which we made last month, in respect to the decoration of carpets, are also applicable to the subject before us. In flooring tiles, as in carpets, pictures are inappropriate, and precisely for the same reasons. Added to the unsuitableness arising from situation, we have another objection to the use of pictures in tiles. The material itself does not appear to be capable of interpreting pictorial effects with any degree of success. Arabesque and figure patterns are however eminently suited to the ornamentation of this kind of work; and independently of the superior fitness of such patterns to the purpose for which they are intended, there is another circumstance which must always render such a style of decoration most advantageous. It must be remembered that, in laying down these tiles, exact correspondence in the parts of the pattern is positively essential. Where every tile contains a given portion of a geometrical design, this correspondence is a natural consequence, and involves much less pains and labor, on the part of the workman, than when the tiles only contain, individually, portions of a large picture. The figure patterns also afford the opportunity of the most judicious introduction of color. This is one of the best characteristics of the arabesque; not only are the combinations of form productive in themselves of an agreeable effect, but they serve as the means of conveying color more effectively, perhaps, than any other style of design. The bright and glittering character, if we may use the expression, of the moresque decoration, depends, in great measure, upon this.

The majolica ware, of which we have spoken, was employed at an early period in Europe for the manufacture of tiles and coverings for walls, as well as for vases; it was, however, more suitable to the latter than to the former application, from its comparatively tender character. There are some specimens of revived majolica tiles in the Exhibition, accompanying the vases.

Before bringing our remarks upon porcelain and earthenware to a conclusion, we must say a few words upon what purports to be a recent feature of English ceramic manufacture;—this is the Parian china. Every question relating to the union of art with manufacture, or to the production of a material, or to methods of manipulation likely to advance the condition of art in this direction, must be looked upon with interest by those possessing sufficient good taste to feel our deficiencies, or a proper desire that we should free ourselves by judicious efforts from the bonds which have been imposed upon us by want of proper cultivation of this branch of art in England. In the invention and employment of the material known as Parian, the enterprise of the inventors has led them a step in the right direction, but it is to be feared that the result is less satisfactory than could be desired. Parian, it must be observed, was introduced as a suitable medium for the interpretation of works of a higher class than that to which porcelain is generally applied. Statuary was particularly to be the object of its employment. It appears to us, however, that there exist some natural difficulties in the way of using such a material for the interpretation of fine art works, that it will not be easy to overcome. The basis of every kind of porcelain and china is the earth called alumina, in other words clay, of greater or less purity: it is a remarkable property of this substance to undergo continued contraction under access of temperature. This contraction it is impossible to control even so far as to make it regular over all parts of a mass of the substance. The property of alumina to contract under the influence of heat is well shewn by Wedgewood's pyrometer, which is an instrument contrived to register the amount of contraction sustained by a pellet of alumina when subjected to a high temperature. The consequence of this contraction is, that in the process of baking any object containing a large quantity of alumina, a certain amount of departure from its normal form necessarily takes place. In the production of copies from a work of art—a finely executed statuette, for instance—it is of the highest importance that the original should be accurately reproduced in every respect. It is the capability of doing this which renders plaster of Paris so invaluable as a means of repeating sculpture or modelling; and it is in this essential particular that Parian seems likely to fail. We are not aware of the real difference between Parian and the old bisqué, so far as regards its capability of resisting a high temperature; but, certainly from many specimens we have seen, it appears to us that the radical defect remains uncured. As the texture and color of Parian are good, it is unfortunate that this defect still remains; for nothing can be more desirable than a cheap and ready means of repeating good works in some durable material. As a medium of mere interpretation, plaster of Paris cannot be surpassed; but the fragility and perishable nature of that substance renders it in many respects useless.

We cannot conclude this short sketch of ceramic art without referring for a moment to an object in the Exhibition which possessed considerable interest in our eyes, and will, no doubt, do so in those of many of our readers. Every one is more or less acquainted with the successful efforts made by the late Mr. Wedgwood in perfecting a certain kind of fine ware—efforts which gave a powerful impulse to ceramic manufactures in England. The object of which we speak is a copy of a small Etruscan vase, and is one of the very earliest productions of Mr. Wedgwood,—made, indeed, on the very first day of his labors at "Etruria." On one side it bears these words—"June 13th, 1769. One of the first day's productions at Etruria, in Staffordshire, by Wedgwood & Bentley;" and on the obverse is the Latin inscription—"Artes Etruriæ renascuntur."

RECENT PATENTS.

To MATTHEW HODGKINSON, *of Redstreet, near Newcastle-under-Lyne, in the county of Stafford, mine agent, for improvements in furnaces or apparatus for smelting ores and minerals, and for the making of pig iron.*—[Sealed 2nd November, 1850.]

THE improvements in furnaces or apparatus for smelting ores and minerals, and for making pig iron, which constitute this invention, have for their object to economize fuel in the above operations, and to dispense with the use of an engine and funnel or opening only,—leaving the others for the admission of air to the interior of the furnace, in the same manner as in the former instance. It will be understood, that the chamber *a, a,* must be furnished with tuyere-holes at its lower part, as in fig. 1, to admit either hot or cold air to the melting metal.

The patentee observes, in conclusion, that although he has mentioned 45 degrees as the angle at which he prefers to incline the floor of the furnace, yet he does not mean to confine himself to such angle or inclination; as other degrees of inclination have been found to give satisfactory results; but, in practice, the above-mentioned angle, or a little more or less, answers better than a nearer approach to the vertical or horizontal line. Neither does he intend to confine himself to the precise arrangement or construction of parts shewn and described; as they may be varied without departing from the nature and object of his invention. He claims, First,—constructing furnaces for smelting ores or minerals, or making pig iron, with an inclined floor, on which the charge of fuel and other materials is supported while under the action of the fire,—the whole being combined and arranged in such a manner as to admit the air to support combustion to the upper part of the charge; and the molten metal being allowed to run down the inclined floor to the pot, well, or hearth. Secondly,—in combination with an inclined floor, the narrow longitudinal opening *c, c,* and chamber or channel *d, d,* below; and also the means shewn and described, or any mere modification thereof, for admitting air at the top or upper part of the chamber *a, a,* and causing the said air to pass through the charge to the under part thereof, and thence to the chimney, after having acted on the incandescent fuel and semi-molten materials.—[*Inrolled May,* 1851.]

To JOHN BALL, *of Ashford, in the county of Kent, engineer, for improvements in applying heat to bakers' ovens and their appendages.*—[Sealed 12th November, 1850.]

THIS invention consists in a new arrangement of the flues of bakers' ovens, whereby a greater amount of available heat, for heating the oven, may be obtained from a given quantity of fuel than heretofore; and, after being so applied, it may be further profitably employed before escaping to the chimney. The improved arrangement of flues does not relate to any one particular shape or form of oven, but, whatever the shape any baker may require, the patentee causes the fire (emanating from a furnace, placed in nearly the usual position) to enter the oven at about nine inches above the floor, instead of, as now, on a level with the floor of the oven; and then (instead of suffering the flame and heated gases to pass off directly to the chimney near the upper part of the oven, as heretofore) he causes the heat, after circulating within the oven, to pass out through two or more flues at the back, on a level with the floor of the oven: these flues should be only about three inches high, but as wide as may be necessary to give the fire sufficient draft. From these flues the flame and heated gases are made to descend and pass underneath the floor of the oven towards the front end thereof, where they are made again to descend into another flue, which conducts them away to act upon a "proving oven" (a well known appendage to bakers' ovens). Or the heat, thus passing from the oven, may be applied to the heating of water, or to other like uses, previously to the final escape of the smoke and heated gases up the chimney.

The floor of the improved oven is constructed of large flat tiles, or any other suitable materials; and this floor is sustained by means of iron or other convenient supporters, so as to form a heating chamber underneath the whole width of the oven, and about six inches high, through which the smoke and heated gases pass in returning to the front of the oven, to be carried off and applied as before stated.

In Plate I., the invention is shewn applied to an ordinary form of bakers' oven. Fig. 5, is a front view of the oven, with the furnace attached to the side thereof; fig. 6, is a sectional plan view, taken in the line 1, 2, of fig. 5; and fig. 7, is a cross section, taken in the line 3, 4, of fig. 6. *a, a*, is the floor and *b, b*, the crown of the oven; *c*, is the oven door; and *d*, is the furnace, which may be applied to either side of the oven, and is connected therewith by a flue *e*. The flame, in passing from the furnace, is guided into the oven by a screen of brickwork *f, f*, which, together with the flue *e*, being raised above the floor, causes the flame to traverse across the oven and play round the walls, and heat the crown thereof. The heated gases generated in the furnace then pass down the flues *g, g*, in the back wall of the oven, into the chamber *h, h*, below the floor *a, a*, and, after traversing along this chamber and heating the floor, they enter the flue *i, i*, at the front part of the oven, and may thence be conducted off to act upon a proving oven, as before stated, or to heat water, prior to escaping into the chimney. *k, k,* are doors, for cleaning out the chamber *h, h.* The furnace is provided with sliding fire-doors *l,* and with similar doors *m,* for the ash-pit.

The patentee claims the so arranging the flues of bakers' ovens, that the flame and heated gases generated in the furnace will be caused to play upon the crown and sides of the oven, and then pass under the floor thereof to heat the same; and, after having heated the oven, will be available for heating a proving oven, or any other appendage to the bake-house requiring the application of heat.—[*Inrolled May,* 1851.]

To SIR FRANCIS CHARLES KNOWLES, *of Lovell, in the county of Bucks, Bart., for improvements in the manufacture of charcoal.*—[Sealed 9th November, 1850.]

THE object of this invention is to manufacture charcoal from light porous vegetable matters, such as spent tanner's bark, compressed or air-dried bog-peat, or other ligneous substances of small specific gravity, without the employment of external firing or heating; and to collect the gaseous and volatile products formed during the dry distillation or decomposition of the raw material.

The apparatus employed by the patentee for carbonizing the above-named substances is shewn at fig. 8, in Plate I. It consists of a circular furnace or cupola of brickwork, the interior of which is cylindrical from A, A, to B, B, and from B, B, to C, C, it is of a conical form, terminating in a funnel-shaped case *a,* of metal. This case is connected by a pipe *b,* with a rotary fan or air-pumps, by means of which the gases and volatile matters are exhausted or drawn from the furnace and delivered into suitable purifiers and receivers; and the opening at the bottom of the case, through which the charcoal is discharged, is closed by a door or valve *c,* acted upon by a weighted lever *d.* A horizontal shaft *e,* extends through the case *a,* and carries two discs, which are situated close to the sides of the case; and in these discs several cylindrical bars are fixed (as shewn at *f,* fig. 9,), extending from one disc to the other, and placed around nearly two-thirds of the circumference of the discs. When these bars are in the position shewn at fig. 9, they serve as fire-bars to support the incandescent matters within the body of the furnace; but on the shaft *e,* being caused to perform half a revolution, that part of the circumference of the discs where there are no bars will be brought uppermost, and the space enclosed by the bars will be filled with the red-hot charcoal; and on the shaft being again turned, so as to bring the bars uppermost, the charcoal will fall into the lower part of the case *a*. The requisite movements of the shaft *e*, are effected by turning a hand-wheel *g*, fixed upon a shaft *h*, which carries a worm *i*, that gears into a worm-wheel *j*, fixed on the end of the shaft *e*. The cover *k*, of the furnace is suspended by means of a cord *l*, passing over pulleys *m*, *m*, and terminating in a counter-balance weight *n*; and when brought down into its lowest position, the lower edge thereof fits into a water-joint around the mouth of the furnace, and closes the same air-tight.

The following is the mode of manufacturing charcoal by means of the above-described apparatus:—The fire-bars *f*, are first covered with dry shavings; when these are lighted, some dry spent tanner's bark, dry or compressed bog-peat, or other vegetable substance to be operated upon, is added carefully, until the mass of ignited matter is about two or three feet thick; and after this, fresh spent bark or other substance is added in small quantities (say from one to two bushels,) from time to time. The rotary fan or pumps connected with the pipe *b*, being now set in motion, air is drawn downwards through the mass of ignited matter in the furnace; and this supply of air must be so regulated as to be sufficient to carbonize, but not to burn, the vegetable substance. The exit passages of the fan or air-pumps are connected with a gas-purifier, so as to drive the gas, or any volatile product that may be formed, into such purifier, and thence into a fixed or portable gasometer. When the furnace is full of charcoal or ignited matter, about one-fifth of its contents are withdrawn by turning the revolving grate; the charcoal descends from the case *a*, into cooling boxes or cases, which are provided with tightly-fitting covers; and, when sufficiently cool, it is transferred into bags, &c. Each time that a quantity of charcoal is withdrawn, the furnace should be supplied at the top with an equal quantity of raw material. At the close of each day's work, the cover *k*, is lowered, so as to leave only a small space (say a quarter of an inch) all round for the escape of vapour or gas during the night. Great care must be taken, when at work, to lute up the external joints and likewise the door or valve *c*. The best lute for the purpose is a mixture of linseed meal, pipe-clay, and linseed oil, prepared as thick as mortar. The luting is most important, as every small crack or opening will admit sufficient oxygen to decompose a great quantity of charcoal, and thus cause considerable loss to the manufacturer. When the contents of the furnace are very compact or dense—either from the nature of the raw material, or the length of time that the operation has been in progress, or from the quantity of aqueous matter remaining in the mass, or from any other cause—the door *c*, is to be unluted and fully opened; and if the draft of air is not visibly improved, a few bushels of charcoal are to be discharged by turning the revolving grate; and then in a few minutes a sharp upward current will be established, passing through the circular grate and escaping at the top of the furnace. When the air has penetrated the whole mass (which is known from the rapidity of the ascending current and the heat it communicates), the operator is certain that the whole mass is ignited and undergoing perfect combustion. If at this time too great a degree of heat is experienced, and white ashes form rapidly at the surface of the furnace, the door *c*, must be closed and luted, and the cover *k*, must be closed instantly, and fresh bark added.

Another part of the invention consists in compressing spent tanner's bark in moulds, and then saturating the same with tar in a boiling or highly-heated state, by immersing them therein. The blocks are then permitted to drain; and charcoal is made therefrom by the means above described, or by placing the blocks in ordinary retorts, heated externally.

The patentee claims, First,—" the means, herein described, of providing charcoal from light, porous, vegetable substances, such as spent tanner's bark, compressed or air-dried bog-peat, or other ligneous substance of small specific gravity." Secondly,—" the means and power of collecting the gaseous and volatile products that are formed during the dry distillation or decomposition of the raw material, without employing external firing or heating."—[*Inrolled May,* 1851.]

To VICTOR EMILE WARMONT, *of Neuilly, Seine, in the Republic of France, for improvements in dyeing wool and other fibrous materials and fabrics.*—[Sealed 2nd November, 1850.]

THIS invention consists in a peculiar method of dyeing wool and other fibrous materials, either in skeins or when manufactured into fabrics.

For this purpose, the patentee employs a series of four-sided bars or rods, made of wood or other suitable material, covered on the upper and lower surfaces with cloth or felt, and connected together by passing small rods through them, as shewn in Plate I. Fig. 10, is a plan view, and fig. 11, an end view of a series of bars or rods, all of the same size; and figs. 12, and 13, are similar views of another series of rods, varying in size, in order to produce stripes of color of different widths. In using these instruments, coloring matter is first applied to the upper surface of a set of rods; the skein or fabric, in a moist state, is laid thereon; and then another set of rods, having coloring matter applied to the under surface thereof, is placed upon the skein or fabric, in the manner indicated by fig. 14: the rods of the two sets must correspond exactly in size and position; and the same coloring matter must be used to both. The sets of rods being firmly secured together, with the skein or fabric between them, are immersed in the dye-bath; and thereby those parts of the skein or fabric which are in the spaces between the rods will be caused to assume the color of the dye-bath, whilst the portions enclosed between the adjacent surfaces of the rods will become tinted with the color which has been applied thereto.

Several sets of rods may be combined together, as shewn at fig. 15, and immersed in the bath. In this figure *a, a,* are the rods; *b, b,* are strips or pieces of wood, extending across the rods; *c, c,* are bars, placed across the combined sets of rods, at top and bottom, and connected together by bolts *d, d,* to the lower ends of which nuts are to be applied; and *e, e,* are other bars, placed at right angles to the bars *c, c,* and connected together by bolts *f, f,* and nuts. Numerous sets of rods, with skeins or fabrics between them, may thus be combined together, so as to admit of being immersed in the bath and removed therefrom with facility.

The sets of rods and skeins or fabrics remain immersed in the dye-bath for half an hour or more, according as may be found requisite. When taken out of the bath, cold water is thrown over the whole; and then the skeins or fabrics are washed and dried, as usual. After drying, the skeins are wound in the ordinary manner; and if the threads or yarns are found to adhere together in the winding operation, they are subjected to the action of steam.—[*Inrolled May,* 1851.]

To JEAN AIMÉ MARNAS, *of Lyons, for improvements in the manufacture of indigo,—being a communication.*—[Sealed 12th December, 1850.]

THIS invention consists in employing a cheap material in the preparation of soluble blues, instead of the expensive material or materials now used, and obtaining thereby an increased product of superior quality.

The soluble indigo blue, called Saxony blue, has hitherto been manufactured in the following manner:—Sulphate of indigo is thrown into water, and woollen skeins or woollen stuffs are dipped therein until they imbibe the blue and leave in the water the sulphuric acid and foreign matters. The stuffs are washed in cold water; they are then dipped in hot water, rendered slightly alkaline, which retains the blue in solution; and after the woollen stuffs have been thus freed from color, they may be used again. The blue liquor being slightly acidulated, while yet warm, deposits a green matter, which is soluble in an alkaline liquor, but precipitates in an acid liquor; and then the water is poured off. The blue is then ready for use, without further preparation; or it may be purified a second time by the same means, if a purer blue is required.

Now this invention consists in employing waste wool, particularly flock wool, or shearings of cloth and other woollen stuffs, instead of the skeins or woollen stuffs. The following advantages are stated to result from the use of waste wool:—First, in its almost pulverulent state, it presents greater surface and absorbs more coloring matter. Secondly, the cost is trifling; for a manufactory employing £2000 worth of cloth, upon the usual plan, would not require above £20 worth of flock wool. Thirdly, the blue which it has taken up it yields readily, and without being injured; whereas woollen stuffs retain a large amount of blue, which can only be extracted with difficulty, and always with injury; and woollen stuffs also very soon lose their absorbing properties,—the parts most exposed to the action of warm alkaline liquor becoming converted into a kind of gummy matter, which deoxidizes and destroys, at each operation, a certain quantity of blue; but flock wool, on the contrary, yields the color as easily as a sponge, may be employed with water less alkaline and at a lower degree of heat, deteriorates less, and does not become gummy. Lastly, the waste of coloring matter which takes place when cloth is employed (amounting to at least 10 per cent.) is avoided by the use of flock wool.

The process for preparing blue, by the use of flock wool, is the same as when woollen stuffs are employed. The sulphate of indigo is thrown in; the acid liquor is slightly heated; and the flock wool, previously cleansed, is put in. At the expiration of half an hour, or thereabouts, the liquor is drawn off; then a fresh quantity of flock wool is put into it; and so on until the whole of the coloring matter is absorbed: any flock wool, which is not completely saturated with color, is again put into liquor in which there is still some coloring matter remaining. Cold water is poured on the flock wool, to carry off the acid and the soluble green matter; after which the wool is thrown into a small quantity of warm water, rendered slightly alkaline by the addition of potash or soda, and well stirred therein; and then it is put into bags, by means of wooden shovels, and pressed. The liquor which runs off is to be slightly acidulated, and filtered whilst yet warm. The green matter, insoluble in an acid solution, remains upon the filter; and the soluble blue passes through it in a purified state, and sufficiently concentrated to solidify in cooling. This operation may be repeated, if it is desired to obtain a purer blue.

In evaporating at a low temperature, indigo carmine may be obtained, more or less concentrated, suitable for dyeing and printing on cloth, and for the preparation of the various soluble blues for linen painting, &c. By prolonged use, flock wool is ultimately rendered useless for the purpose of preparing soluble blue; but it still retains all its virtue as a nitrogenous substance, either for employment as manure or for manufacturing prussiate of potash. The acid waters may be concentrated and used in the manufacture of various sulphates (copperas, for example), or be mixed with coleothar, in order to produce, by calcination, the fuming sulphuric acid, known as Nordhausen acid. The patentee states, that he does not intend to point out improvements in such preparation of blue, of sulphuric acid, of sulphates, &c.; and he does not claim any right to the manufacture of these matters. He merely wishes to indicate that the blue, extracted by his process, can be used for obtaining all the products which have for their base the sulphate of indigo, and to point out the means of making the refuse of the operation useful.

In conclusion, the patentee says, "I limit myself to claiming the invention of a better and more economical process or method of preparing the Saxony blue, and of extracting easily, economically, and entirely, the indigo blue from the dissolving and washing waters produced in the manufacture of indigo carmine, and other soluble blues; and I sum up this process in saying, that it principally consists in the employment, for this purpose, of waste wool, and particulary flock wool, which combines in itself all the necessary properties."—[*Inrolled June,* 1851.

INSTITUTION OF MECHANICAL ENGINEERS, BIRMINGHAM.

(Continued from page 478, Vol. xxxviii.)

The reading of Mr. Gibbons' paper, *on the ventilation of mines*, called forth the following inquiries and remarks :—

Mr. Clift inquired whether, in a colliery of considerable extent, Mr. Gibbons would always sink the shaft at the extreme outside, in the highest point of the strata, for draining off the gas, or in the centre of the area, so as to have the work lying all round the shaft; and whether, in a large work, the air-head would not in some part have to descend towards the shaft.

Mr. Gibbons replied, that he would always sink the shaft at the extremity of the work, at the highest point of the coal strata, so as to drain off the gas from the whole of the coal; and he drove the air-heads always ascending towards the shaft, intersecting the coal strata every fifteen yards with vertical passages, through which the gas was constantly drained off into the air-heads.

Mr. Cowper wished to know, if the shaft was sunk at the highest point of the strata, how the water was carried off?

Mr. Gibbons explained, that where it was required, he sunk a water-pit for the drainage at the lowest point, so as to drain the *water* from the *lowest* point of the strata, and the *gas* from the *highest*. He considered that 5000 cubic feet of air per minute were more than sufficient for any area of colliery that ought to be worked by one pit, provided the gas was previously drained from the coal in the manner he had described.

Mr. Shipton supposed that the nearer the ventilating chimney was to the pit's mouth, or the shorter the horizontal air-way was, the greater would be the ventilating power.

Mr. Gibbons said he found that made little difference,—the air-chimney being simply a continuation of the air-head, which was already horizontal in the workings, and the distance to the ventilating chimney being, in any case, quite insignificant in comparison to the length of the air-head.

The Chairman wished to understand how Mr. Gibbons was able to take out the whole of the pillars, as stated in his paper, so as to remove the whole of the coal.

Mr. Gibbons explained, that he began in the middle of the thickness of coal, and worked the upper half first, commencing at one extreme side of the work, and driving a series of parallel roads, about thirty yards apart, through the whole extent to the opposite side of the area of coal to be got; he then worked backwards from the extremity, excavating the whole of the upper thickness of fifteen feet of the coal, and taking advantage of the superincumbent weight of the roof to bring down the coal;—the roof continued gradually to creep down, following the work, and filling up the excavated space that was left behind. The upper half of the coal was all got out by these means, and the roof all settled down, filling up the space. He then proceeded to work the lower half in a similar manner, by driving a fresh series of parallel roads at the bottom of the coal;—commencing at the same line as that from which the upper coal had been worked. The roof was found to be settled down after the fall, so as to form a new roof to the lower workings, quite firm and sound enough for the purpose; the first air-heads fell in gradually with the progress of the first excavation, being no longer required; but the communication with the air-chimney at the commencement of the work remained undisturbed; and the roof was left so porous after the fall, that the gas was constantly flowing off into the air-chimney from the lower coal workings, as readily as water filters through a bed of sand. By this mode of working, a very large quantity of coal per day could be got at one pit: it was only limited, indeed, by the winding power available, as the face of the work could be extended at pleasure.

Mr. Slate presumed, from Mr. Gibbons' paper, that the proportion of slack obtained was less, and the coal more, than usually obtained in the Staffordshire pits.

Mr. Gibbons said he did not obtain any more slack per acre, but a much greater quantity of coal. By the old system, they got about one-third, and left two-thirds of the coal; but now none was left.

Professor Hodgkinson remarked, that there were, no doubt, great difficulties in effectually securing the object discussed in the able paper read by Mr. Gibbons. When so great an amount of matter was excavated from the bottom, there must be a proportionately great settlement in the ground above. In the neighbourhood of Northwich, Cheshire, the brine melted the pillars that were left in the salt mines, and sinking was constantly going forward; and when the pillars were wasted by time, the whole ground settled down together.

In reply to an inquiry from Mr. Adams as to how—where a coal mine was situated in a deep valley—Mr. Gibbons would place the pit, he stated that he would drain off the water downwards, and sink a shaft at the upper level of the strata to drain off the gas.

The Chairman said there could be but one opinion upon the able manner in which Mr. Gibbons had brought the subject of coal-mine ventilation under their consideration. Of late years, the many fearful and frightful accidents which had occurred, owing to the accumulation of gas in coal mines, had rendered the question one of the highest importance, and any person who could suggest a remedy for an evil, so disastrous in its consequence, would prove himself the friend of humanity. Proper ventilation appeared to be the only remedy, and he hoped the excellent paper that had been read would receive, not only from the members of the Institution, but from the public generally, that attention which it so justly merited.

The following paper, by Mr. JOSEPH BEASLEY, of Smethwick, was then read:—

On a new machine for blooming iron.

The purpose of this machine, which has been invented and patented by Mr. Jeremiah Brown, is to perform the process of blooming the iron from the puddling furnace, which is usually done by hammering, and in some instances by squeezing;—the object being to squeeze out the cinder from the puddled ball, and to compress the iron into a form ready for rolling into a bar, which is done at the same heat.

The machine is shewn, in sectional elevation, in Plate I., at figs. 16 and 17. It consists of three large excentric rolls *a*, *b*, *c*, placed horizontally in the strong holsters *d*, *d*,—the centres of the rolls being arranged in a triangular position, and the bottom roll *c*, nearly central between the two top rolls *a*, *b*. These rolls all rotate in the same direction, as shewn by the arrows, and are driven by a centre pinion *e*, (fig. 17,) working into three pinions of equal size *f*, *f*, *f*, fixed on the roll spindles: in the present machine, the driving power is applied direct to the bottom roll, by means of a large wheel on its shaft, for the convenience of carrying the main shaft under the floor; but it could be applied to the centre pinion, if preferred. The rolls are cast solid with their journals, like ordinary rolls, and are driven in the usual manner.

The roll-faces are 16 inches long; and the bottom roll has strong flanges at each end, 8 inches deep, between which the two upper rolls work: the object of these flanges is to upset or compress the ends of the bloom, as the iron in the operation is elongated, and the ends are forced against the flanges, which makes them square and sound; as shewn by the specimen of a bloom exhibited to the meeting. The top roll *a*, has a large hollow in which the puddled ball *i*, is placed by the puddler; and this roll carries the ball round, and drops it into the space between the three rolls, as shewn at fig. 17,—this space being at that moment at its largest capacity. The three projecting points *k*, *k*, *k*, of the rolls immediately impinge upon the ball, and compress it forcibly on the three sides; and, giving a rotating motion to the ball at the same time, they have a very powerful kneading action upon the iron, squeezing out the cinder very effectually, which flows freely away down each side of the bottom roll. The space between the rolls gradually contracts, from the excentric or spiral form of the rolls,—thereby maintaining an increasing compression on the iron on all sides and the ends, until it is liberated by the points *l*, *l*, *l*, simultaneously passing the bloom *m*, which falls down in the direction of the arrow, and is discharged from the machine at the same moment that another ball is dropped in at the top of the machine. The projecting teeth on the surface of the rolls assist this action, by seizing hold of the iron and kneading into it as it rotates. These teeth gradually diminish in projection, the last portion of each roll being plain; and the bloom is consequently turned out in a smooth compact form. The space between the flanges of the bottom roll is widened for a short distance beyond the point *l*, for the purpose of allowing the bloom to drop out readily, and for admitting the fresh ball.

Provision is made to prevent risk of breaking the rolls by any unusual size of ball being put in, by means of the two large triple-threaded screws *n*, *n*, which bear upon the journals of one of the rolls *b*. A small pinion on the head of each of these screws works into a large pinion fixed between them, which has a horizontal lever fixed to it, carrying a balance weight at the end. This weight causes a constant equal pressure of the roll; and in the case of any ball of extra size being put into the machine, the screws yield by turning back and lifting the weight to the extent that may be required; so that a large ball will be worked with the same pressure and in the same effective manner as the smaller sizes. A continual supply of water is run on to all the journals throughout the machine, which prevents any possibility of the journals becoming hot, even when the machine is in constant work.

The advantages derived from this machine, are stated to be—1st. The saving of time effected in the operation; as the machine makes five revolutions per minute, and turns out five blooms in that time; and consequently each bloom is only 12 seconds, instead of from 60 to 80 seconds (the time required in the usual process of hammering): the iron from the machine is therefore passed through the bar rolls at considerable greater heat than that from the hammer, and is consequently softer and better worked in that process.

2nd. The saving of expense in manufacture; as the machine is self-acting, and requires no men to attend the working; whereas, the hammer requires an experienced hammer-man in all instances, and sometimes two, depending on the number of furnaces the hammer has to work for; and these men are entirely dispensed with by the machine being self-acting. An endless chain is also being added to the machine, working in an inclined direction from the lower side of the bottom roll, for the purpose of catching the bloom as it falls from the machine, and carrying it up direct to the bar rolls without any manual labor. In consequence of the machine turning out five or six blooms in the same time that one bloom is completed by the hammer, it is capable of working for a much larger number of furnaces, indeed, for as many furnaces as can be placed within a convenient distance for working. Another advantage resulting from this circumstance is, that the puddlers are never liable to be kept waiting for their at Mr. Beasley's works, and saw many blooms made by it, and all equal to the sample exhibited; he should say that the specimens of iron produced were fair specimens of the iron made; and his impression was that he never saw iron turned out more perfectly. The operation of the machine was very satisfactory; and it was important for the blooms to be all worked in a uniform manner, and made of even surface.

Mr. Siemens said he had tried an experiment to ascertain the comparative power required to work the machine and the ordinary hammer, by taking the indicator diagrams, exhibited to the meeting, of the power of the engine when working without any load, and then the power when driving the machine alone, and when driving the hammer alone. The indicator diagrams were taken at various periods of the revolution of the machine, to ascertain the average power; as the power exerted at the commencement of the revolution appeared to be very small, and it was mainly concentrated at the last portion. The average power of the engine was increased about 4-horse-power whilst the machine was working, and about 6-horse-power by the hammer; but as the former power was in action for only 12 seconds in the operation of blooming, and the latter was 60 to 80 seconds in action, the total comparative power in the two cases would be as 48 (4 × 12) to 420, (6 × 70), or as 1 to 9,—shewing the power absorbed by the hammer to be nine times as great as that by the machine. This, however, might require some correction, on account of the momentum of the engine fly-wheel, from some power being given out at the moment by its velocity being retarded; he could not detect any loss of velocity in the present case; but a more accurate measure might be obtained of any differential velocity; and he hoped to have an opportunity of making a more complete trial of the comparative power of the machine and the hammer.

The Chairman inquired whether there was not danger that the machine would lap up more cinder in the iron than was usually the case in the common process of hammering.

Mr. Beasley said there was not any danger of it; and he considered it was impossible, from the action of the machine, that any cinder could be lapped up in the iron; as there was no possibility of a portion of the iron getting lapped over in the process and enclosing some of the cinder in a pocket or hollow,—which was, however, the case occasionally with the hammer.

Mr. Walker remarked, that there were traces of cinder in the specimens of iron from the machine; and he thought there must be some portions of cinder lapped up in the process. He did not think the machine would be so effective as the hammer in extracting the cinder from the ball;—besides which, the hammer was a good test for the quality of the iron.

Mr. Cowper said he had carefully observed the working of the machine, and considered its action was very perfect. The iron was subject to an enormous pressure; and he was decidedly of opinion that no cinder was lapped up in it. He did not mean to say that the machine produced better iron than the hammer, but it was at least quite as good.

Mr. R. Williams observed, that if iron was imperfectly puddled, the hammer would knock it to pieces, and shew the defect in the quality of the iron; but he thought the machine would roll the iron all up, whether good or bad. He was of opinion that, from the rolling action of the machine, the cinder would be lapped up in the iron.

Mr. Beasley said, it was found that, if the iron was not properly worked, or was "green" iron, it was shewn at once by the machine tearing it to pieces, although in other squeezers it might still be wrapped up into a ball.

Mr. R. Williams considered the cost of the machine, and expense of keeping it in repair, would be an important consideration, and questioned whether it would not be liable to accident and stoppage, from its complication, compared to the hammer. He thought the different sizes of balls would not be equally well worked, as they were with the hammer.

Mr. Beasley replied, that the machinery was precisely similar and not more complicated than the ordinary rolls, and no more liable to go wrong. This machine had been working four months without accident, except one which was from a defect in the original make; and he considered it was decidedly less liable to stoppage and delay than the hammer. It was not intended to do away with the hammer altogether; but when larger sizes of iron were required, larger machines might be constructed for such a purpose. The machine was suitable for all the various sizes of iron in ordinary work, by using the regulating screw.

Mr. Siemens thought the machine would work and last well, from the small power required to keep it in operation.

Mr. Slate observed, that the machine possessed an advantage in being driven without the heavy cams and driving power required for the hammer.

Mr. Beasley said, he had never seen a bloom from the hammer perfectly free from cinder in the regular work; and those produced by the machine were decidedly more free from cinder than those produced by the hammer, and they never had any hollow in the body of the iron.

Mr. R. Williams remarked, that rolled iron was generally considered inferior to hammered.

Mr. Beasley replied, that the process performed by the machine was very different to that of rolling, from the action of the three surfaces;—he referred to the samples exhibited, to shew the superior quality of the iron produced.

Mr. Slate observed, that such specimens were not a true test;—it depended greatly upon how they were broken.

Professor Hodgkinson said, he had better acquaintance with the strength of iron than the process of manufacture; he had at first rather strong prejudices against the machine; he did not think it was exactly the right mode in which to get rid of the cinder; and it appeared to him likely to lap up some of the cinder; but he thought the objections he at first entertained were considerably lessened: the samples of iron from the machine, he must say, looked remarkably well.

The Chairman observed, that the merit of the machine depended upon the relative quality of the iron produced, and there appeared a difference of opinion upon that subject. It was desirable that this point, as well as the cost of the different processes, should be ascertained, and laid before the Institution; and he therefore suggested that the inquiry and experiments should be further pursued, and the results reported to a future meeting.

List of Patents

That have passed the Great Seal of IRELAND, from the 2nd May to the 17th June, 1851, inclusive.

To Gaetan Kossovitch, of Myddleton Square, in the county of Middlesex, Gent., for improvements in rotatory engines,—being a foreign communication.—Sealed 2nd May.

Henry Crosley, of the Grove, Camberwell, in the county of Surrey, engineer, for certain improvements in the mode or modes, method or methods, of manufacturing raw sugar from beetroots; and in preparing such roots for that purpose; and in obtaining saccharine matters from such roots when prepared, or in a raw state; and in the machinery and apparatus, and combination or combinations thereof, applicable for that purpose;—part of which modes or methods, and also part of the machinery and apparatus, with certain adjuncts and combinations, are applicable to the refining of beet and other sugar, and for other useful and manufacturing purposes.—Sealed 6th May.

John Gwynne, of Lansdowne Lodge, Notting Hill, in the county of Middlesex, merchant, for improvements in machinery for pumping, forcing, and exhausting of steam fluids and gases; and in the adaptation thereof to producing motion to the saturation, separation, and decomposition of substances,—being a foreign communication.—Sealed 17th May.

James Hamilton, of London, engineer, for improvements in machinery for sawing, boring, and shaping wood.—Sealed 22nd May.

William Beckett Johnson, of Manchester, in the county of Lancaster, manager for Messrs. Ormerod and Son, engineers, for certain improvements in steam-engines, and in apparatus for generating steam; such improvements in engines being wholly, or in part, applicable where other vapours or gases are used as the motive power.—Sealed 10th June.

Adolphus Oliver Harris, of High Holborn, in the county of Middlesex, philosophical instrument maker, for improvements in barometers,—being a foreign communication.—Sealed 10th June.

List of Patents

Granted for SCOTLAND, subsequent to 22nd May, 1851.

To John Gwynne, of Lansdowne-lodge, Notting-hill, in the county of Middlesex, merchant, for improvements in machinery for pumping, forcing, and exhausting of steam fluids and gases, and in the adaptation thereof to producing motion, to the saturation, separation, and decomposition of substances,—being a communication.—Sealed 28th May.

Charles Hardy, of Lowmoor, Yorkshire, engineer, for certain improvements in the manufacture of scythes,—being a communication.—Sealed 30th May.

William Geddes, of Glasgow, dyer, for certain improvements in the production of ornamental fabrics.—Sealed 6th June.

John Mac Nab, of Midtown-field, Renfrewshire, bleacher, for certain improvements in stretching and drying textile fabrics or materials, and in the machinery or apparatus employed therein.—Sealed 16th June.

Isaac Hazlehurst, of Marton, parish of Dalton, county of Lancaster, steel refiner, for certain improvements in the manufacture of iron.—Sealed 16th June.

Frederick Crace Calvert, of Manchester, professor of chemistry, for a new application of certain fluids for manufacturing extracts, applicable to the processes of dyeing, printing, and tanning, and in the apparatus connected therewith.—Sealed 18th June.

William Beadon, Jun., of Taunton, for improvements applicable to the roofing of houses, buildings, and other structures.—Sealed 19th June.

James Hartley, of Sunderland, for improvements in the manufacture of glass.—Sealed 19th June.

George Robins Booth, of London, engineer, for improvements in the manufacture of gas.—Sealed 19th June.

Henry Craven Baildon, of Edinburgh, for improvements in writing, printing, or marking letters, characters, or figures, upon paper, parchment, or other material properly prepared for that purpose.—Sealed 19th June.

Christopher Nickels, of York-road, Lambeth, for improvements in the manufacture of woollen and other fabrics.—Sealed 19th June.

Alexis Delemer, of Radcliffe, county of Lancaster, civil engineer, for certain improvements in the application of coloring matter to linens, cottons, silk, woollen, and other fabrics,—and to linen, cotton, silk, woollen, and other weft; and also in machinery or apparatus for these purposes.—Sealed 19th June.

New Patents
SEALED IN ENGLAND,
1851.

To Thomas Parker, of Leeds, in the county of York, broker, for improvements in machinery for opening, cleaning, and preparing fibrous substances; and for manufacturing felted fabrics. Sealed 3rd June—6 months for inrolment.

John Hopkinson, of Oxford-street, in the county of Middlesex, piano-forte manufacturer, for improvements in piano-fortes,—being a communication. Sealed 3rd June,—6 months for inrolment.

William Bridges Adams, of Adam-street, Adelphi, in the county of Middlesex, engineer, for certain improvements in the construction of roads and ways for the transit of passengers, of materials, and of goods; also in buildings, and in bridges, and in locomotive engines, and carriages; parts of which improvements are applicable to other like purposes. Sealed 3rd June—6 months for inrolment.

Cornelius Alfred Jaquin, of New-street, Bishopsgate, mechanist, for improvements in the manufacture of nails, pins, tacks, screws, and other similar articles. Sealed 3rd June—6 months for inrolment.

Isaac Hazlehurst, of Marton, in the parish of Dalton, in the county of Lancaster, steel refiner, for certain improvements in the manufacture of iron. Sealed 3rd June—6 months for inrolment.

James Banister, of Birmingham, in the county of Warwick, brass-founder, for improvements in the manufacture of metallic tubes for steam boilers and other uses. Sealed 7th June—6 months for inrolment.

Robert Alexander Kennedy, of Manchester, cotton spinner, for improvements in machinery applicable to engines for carding cotton and other fibrous substances. Sealed 10th June—6 months for inrolment.

William Henry Fox Talbot, of Laycock Abbey, Chippenham, in the county of Wilts, for improvements in photography. Sealed 12th June—6 months for inrolment.

John Emanuel Lightfoot, of Broad Oak, Accrington, in the county of Lancaster, calico printer, and James Higgin, of Coburg-terrace, Manchester, chemist, for improvements in treating and preparing certain coloring matters, to be used in dyeing and printing. Sealed 12th June—6 months for inrolment.

Frederick Crace Calvert, of Manchester, chemist, for a new application of certain fluids for manufacturing extracts applicable to the processes of dyeing, printing, and tanning; and in the apparatus connected therewith. Sealed 12th June—6 months for inrolment.

John Chatterton, of Birmingham, agent, for certain improvements in protecting insulated electro-telegraphic wires; and in the methods and machinery used for the purpose. Sealed 12th June—6 months for inrolment.

William Birkett, of Bradford, in the county of York, agent, for improvements in obtaining soap from wash waters. Sealed 12th June—6 months for inrolment.

Felix Charles Victor Leon Levacher d'Urcle, of Paris, France, farmer, for improvements for increasing the produce of autumn wheat. Sealed 12th June—6 months for inrolment.

Edward Lyon Berthon, of Fareham, in the county of Hants, clerk, Master of Arts, for improvements in boats and in instruments for sounding and indicating the rise and fall and rate of currents. Sealed 12th June—6 months for inrolment.

James Hinks, of Birmingham, in the county of Warwick, manufacturer, for certain improvements in the construction of metallic reels for winding cotton, silk, and other threads; and in machinery for making the same. Sealed 14th June—6 months for inrolment.

Prosper Durand, of Rue Maragrand 18, Paris, merchant, for improvements in communicating intelligence. Sealed 17th June, 6 months for inrolment.

Thomas Crook, of Preston, in the county of Lancaster, manufacturer, and James Mason, of Preston, aforesaid, warper, for certain improvements in looms for weaving. Sealed 17th June—6 months for inrolment.

Francis John Swaine Hepburn, of Notting Hill Terrace, in the county of Middlesex, Captain H. P., unattached, for improvements in the manufacture of carriages and other vehicles. Sealed 17th June—6 months for inrolment.

Godfrey Ermen, of Manchester, cotton spinner and manufacturer, for certain improvements in the method of and apparatus for finishing yarns or threads. Sealed 17th June—6 months for inrolment.

John Machin, of Stockport, in the county of Chester, manufacturer of boots and shoes, for certain improvements in boots and shoes. Sealed 17th June—6 months for inrolment.

Richard Fletcher, of Blackdowns Farm, in the county of Gloucester, farmer, for an improvement iu obtaining motive power. Sealed 21st June—6 months for inrolment.

CELESTIAL PHENOMENA FOR JULY, 1851.

D.	H.	M.	
1			Clock before the ☉ 3m. 23s.
	—		☽ rises 6h. 14m. M.
	—		☽ pass mer. 2h. 17m. A.
	—		☽ sets 10h. 8m. A.
	14	0	☽ in Perigee
	14	46	☉ in Apogee
2	3	26	♃'s second sat. will em.
4	14	18	☿ in the ascending node
5			Clock before the ☉ 4m. 8s.
	—		☽ rises 11h. 33m. M.
	—		☽ pass mer. 5h. 53m. A.
	—		☽ sets 11h. 59m. A.
	9	44	♃ in conj. with the ☽ diff. of dec. 4. 9. S.
	11	8	☽ in □ or first quarter
6	8	51	♃ in □ with the ☉
9	3	54	☿ in Perihelion
10			Clock before the ☉ 4m. 56s.
	—		☽ rises 5h. 45m. A.
	—		☽ pass mer. 10h. 5m. A.
	—		☽ sets 1h. 43m. M.
12			☽ eclipsed invis. at Greenwich
13	7	14	Ecliptic oppo. or ○ full moon
14			Occul. 20 Capri, im. 8h. 34m. em. 9h. 19m.
	9	28	♃'s first sat. will em.
15			Clock before the ☉ 5m. 33s.
	—		☽ rises 9h. 36m. A
	—		☽ pass mer. 1h. 29m. M.
	—		☽ sets 5h. 58m. M.
	5	38	☿ in sup. conj. with ☉
16			Mercury R. A. 7h. 45m. dec. 22. 51. N.
	—		Venus R. A. 6h. 12m. dec. 23. 6. N.
	—		Mars R. A. 3h. 53m. dec. 19. 41. N.
	—		Vesta, R. A., 16h. 43m. dec. 19. 29. S.
	—		Juno, R. A., 16h. 58m. dec. 4. 56. S.
	—		Pallas, R. A., 2h. 43m. dec. 0. 4. S.
	—		Ceres R. A., 4h. 55m. dec. 19. 47. N.
	—		Jupiter R. A., 12h. 57m. dec. 4. 45. S.
16			Saturn R. A., 2h. 8m. dec. 10. 22. N.
	—		Uranus R. A., 2h. 8m. dec. 12. 26. N.
	—		Mercury pass mer. 0h. 10m.
	—		Venus pass mer. 22h. 39m.
	—		Mars pass mer. 20h. 17m.
	—		Jupiter pass mer. 5h. 21m.
	—		Saturn pass mer. 18h. 30m.
	—		Uranus pass mer. 18h. 30m.
17	10		☽ in Apogee
19	11	52	☿ greatest hel. lat. N.
20			Clock before the ☉ 5m. 58s.
	—		☽ rises 11h. 21m. A.
	—		☽ pass mer. 5h. 7m. M.
	—		☽ sets 11h. 23m. M.
21			Occul. *x* Ceti, im. 12h. 14m. em. 12h. 40m.
	7	33	♅ in conj. with the ☽ diff. of dec. 5. 2. N.
		53	♄ in conj. with the ☽ diff. of dec. 2. 58. N.
	10	39	☽ in □ or last quarter
22	19	12	Vesta stationary
23	5	35	♀ in the ascending node
	20	53	♂ in conj. with the ☽ diff. of dec. 3. 43. N.
24			Occul. ω in Tauri, im. 13h. 58m. em. 14h. 50m.
25			Clock before the ☉ 6m. 11s.
	—		☽ rises 1h. 5m. M.
	—		☽ pass mer. 9h. 2m. M.
	—		☽ sets 5h. 8m. A.
	—		Occul. χ^4 Orionis, im. 13h. 24m. em. 14h. 12m.
26	20	14	♀ in conj. with the ☽ diff. of dec. 1. 6. N.
27	4	12	♄ in □ with the ☉
	13	52	♅ in □ with the ☉
			☉ partial eclipse
28	2	3	Begins
	3	11	Greatest phase
	4	15	Ends
	2	40	Ecliptic conj. or ● new moon
29	3	11	☿ in conj. with the ☽ diff. of dec. 0. 36. S.
	14	0	☽ in Perigee

J. LEWTHWAITE, Rotherhithe.

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THE INDUSTRIAL EXHIBITION.

GENERAL REMARKS.

It would seem to be a misfortune peculiar to writers, that, whatever the subject they may take in hand, it can seldom be satisfactorily treated in the space originally assigned it; the tendency being for the subject to grow as the work proceeds. An author may have his design never so clear in his mind, even to the mapping out of the various chapters and sections of his book,—but no sooner does he fairly set to work, than the matter for the first chapter requires subdivision and expansion, and, in like manner, for the elucidation of all his important points, various details become necessary: in fact, he is lucky if a host of fresh notions do not rush upon him, and struggle for a place upon his pages. In the task which we have undertaken, and which, at the outset, we truly enough termed Herculean, we find ourselves thus beset—there is, in fact, full occupation for a long life to accomplish for every branch of industry indicated in the Exhibition, what we have really undertaken for a few of the most important. Up to the present time the Exhibition is most imperfectly noted in the Official Catalogue, and the parts of the Illustrated Catalogue already completed are little more than the shilling book amplified by the occasional insertion of exhibitors' advertisements in the body of the work, set off by borrowed woodcuts: the completion of this series, in the style in which it has been begun, together with the publication of the praiseworthy little handbooks of Mr. Hunt, are all that may be expected from official sources. Now, we think that the very imperfections of these works is a presumptive proof of the practical impossibility of treating, with any amount of intelligibility, in a moderate compass, the various branches of manufactures displayed or indicated in the Great Exhibition; the rational course, therefore, for us to pursue is, to continue to lay before

RAW MATERIALS.

From what was previously stated concerning the impurities which exist in crude coal-gas, it must be evident to those conversant with the principles of chemistry, that these impurities can never be thoroughly removed by any single agent, for some of them possess affinities diametrically opposite to the others. Thus, any means employed to absorb carbonic acid and sulphuretted hydrogen gases would leave the ammonia free; whilst an agent capable of combining with the latter would not at all affect the former impurities. Hence, the process of coal-gas purification, as now carried on at the best gas works, is divided into two distinct parts. By one of these the whole of the ammonia and a portion of the carbonic acid and sulphuretted hydrogen are taken away,—by the other the remainder of the carbonic acid and sulphuretted hydrogen are totally removed; so that the gas ultimately passes forth to the consumer free from all contamination, either by ammonia, carbonic acid, or sulphuretted hydrogen gas. And the absence of these impurities may at any time be demonstrated by applying the following simple tests:—Litmus paper, slightly reddened by an acid, will undergo no change when held for a few minutes in a current of the gas; this proves the absence of ammonia, for otherwise the paper would become blue. Paper, dipped into a solution of the acetate of lead, and held in a current of the gas, will remain white; which shews that the gas is destitute of sulphuretted hydrogen, as, under contrary circumstances, it would assume a deep brown or black hue. Lastly, if the gas be allowed to blow for a few minutes through a clear solution of lime in water, the solution will not become milky and turbid, as it would do if carbonic acid were present in the gas. No coal-gas which does not vindicate its purity by resisting the analytical power of the above tests can be regarded as sufficiently good for the purposes of illumination and heating.

To separate the ammonia from coal-gas a variety of modes are at present in use; thus, Mr. Lowe employs cold water, minutely divided in an apparatus which he terms a "scrubber," and which is perfectly analogous to the *cascade chemique* of Clement Desormes. With a similar view Mr. Palmer mixes the gas with steam, and then subjects the mixture to a condensing temperature, so as to obtain water, minutely divided in drops, like rain or dew, and therefore presenting a considerable surface for chemical action. Mr. Johnson prepares a compound, consisting of sulphate and biphosphate of lime, by acting on burnt bones with sulphuric acid; and this he disposes in trays, so as to absorb the ammonia and produce a mixture of sulphate of ammonia and phosphate of lime, which, as might be expected, he finds an extremely efficient fertilizing agent. Mr. Laming employs a solution of chloride of calcium or muriate of lime, absorbed into saw-dust, which he disposes in the same manner as that followed by Mr. Johnson, and by which the muriate of lime is gradually decomposed, with the formation of carbonate of lime and muriate of ammonia,—the resulting compound being either valuable as a manure, or as a source for the manufacture of sal-ammoniac. Sulphate of lime, and various other earthy and metallic salts, have also been proposed and employed,—such as the sulphates of magnesia, alumina, zinc, iron, and manganese, and the chlorides of the same metals. With the exception of the sulphate of lime they do not, however, seem to possess any advantage over the modes we have mentioned as now in use for the absorption of ammonia; and hence it may be as well to examine more minutely the action of those methods, and their effect upon the gas undergoing purification. The process of Lowe is extremely simple in theory, and, where the economy of the ammonia is not an object of importance, has much to recommend it. Here the ammonia is, so to say, washed out by means of water; and the application of the scrubber may either be made before or after the other impurities are taken away, with, however, this difference in the result. If the gas, after quitting the condenser, is passed at once into the lime purifier, and the scrubber applied afterwards, nothing but ammonia will be removed by the water; but if the scrubber be employed in the first instance, then, with every atom of ammonia taken away, one of carbonic acid or sulphuretted hydrogen will follow, and hence a great economy of lime in this way arises; for the ammonia, though itself an impurity, thus becomes a purifying agent, and the liquid from the scrubber consists not of aqueous ammonia merely, but of a solution of carbonate and hydrosulphate of ammonia. It is, however, very difficult to separate the whole of the ammonia, either free or combined with carbonic acid, by Lowe's scrubber, without the application of a very large body of water; and it has been suggested, that excessive ablution diminishes considerably the illuminating power of coal-gas. This circumstance, if true—and it is far from improbable—demonstrates the necessity of limiting the action of water upon gas, and must, in some degree, interfere with the employment of an otherwise invaluable instrument of purification. The plan of Palmer is precisely similar, in its effect, to the scrubber of Lowe, but more costly, and, except when conducted with great care, less efficacious, as the entire success depends upon the perfection of the condensation; for, unless the condensed water be cooled down to the mean temperature of the atmosphere, little or no ammonia will combine with it; and there is, moreover, a still greater danger of injuring the light-giving power of the gas by condensed steam than by an equal weight of cold water. This method cannot, therefore, be considered as equal to the former, more especially when coal-gas, of low specific gravity, is to be purified. The mere recital of Johnson's process almost details its mode of action; and it would scarcely be necessary to say more concerning it, but for the contrast it presents to that of Laming, and the substances before alluded to. If the phosphate of lime or bone-earth, mentioned as part of Johnson's mixture, be regarded as a sponge for holding the sulphuric acid which he employs, then the ammonia is taken up from the gas by simple elective affinity with the production of sulphate of ammonia; and this is, beyond doubt, a true explanation of the *modus operandi* in Johnson's case. Here, however, it will be noticed, that nothing but ammonia is removed, for the carbonic acid and sulphuretted hydrogen remain unaffected; consequently this system might be employed either before or after lime purification. Now, Laming's plan differs altogether from this; and, as will readily be seen, admits of application only before lime purification. The foul coal-gas from the condenser contains (as we pointed out in our last number) carbonate of ammonia in a gaseous condition; and it has just been shewn, that the process of Laming depends upon the use of muriate of lime. But, at the ordinary temperature of this country, these two substances are incompatible with each other; and, consequently, as fast as the carbonate of ammonia is brought by the current of gas into contact with the muriate of lime, mutual decomposition ensues, and both the ammonia and carbonic acid are solidified; the former becoming converted into muriate of ammonia, and the latter into carbonate of lime, by an interchange of elements with the muriate of lime used in the process; therefore the result differs thus far from that of Johnson,—that carbonic acid, as well as ammonia, is taken from the gas, and a consequent saving of lime, or other purifying material, effected: of course sulphate of lime would act in the same way, though less powerfully; whereas metallic salts, in general, having more affinity, after decomposition, for sulphuretted hydrogen than for carbonic acid, will produce an economy of lime by removing the former and not the latter impurity. Such then is a descriptive outline of the methods actually followed at the present day for the purification of coal-gas from the ammonia it contains; and although seemingly abundant enough to have exhausted the subject, yet there is still an extensive field open to improvement even here.

Amongst the large class of ammoniacal compounds known to chemists, it seems strange that no one has yet taken advantage of that interesting series which suffers decomposition by the mere application of a moderate temperature, evolving at the same time pure ammoniacal gas, and yielding, as a residue, the substance originally employed for purification. We shall enumerate but one or two substances of this kind, for the purpose of illustrating our argument,—leaving the whole question as open as ever to practical investigation. When phosphate of magnesia is exposed to the action of ammoniacal gas, its acid becomes divided in such a way as to produce the triple salt called ammoniaco-phosphate of magnesia; and as this is a much more insoluble substance than the simple phosphate, we have only to pass impure coal-gas through a solution or aqueous mixture of the latter, to insure the precipitation of all the ammonia contained in the gas; whilst, at the same time, the compound which it has formed with the phosphate of magnesia is very easily decomposed, so as to admit of a continuous usage of the same material; for, at a temperature considerably below a red heat, the triple phosphate of magnesia parts with all its ammonia, and becomes simple phosphate again, with the renewal of its primitive power as an absorber of ammoniacal vapours. But the ammonia which is expelled by heat might very easily be condensed in water, and thus originate a valuable commodity for the market. By this means, there can be no doubt, phosphate of magnesia might be employed over and over again in the purification of coal-gas, whilst the ammonia procured from it would contain neither sulphur nor any other impurity. An iron vessel might be used for the distillation; and if too high a heat was not given to the phosphate of magnesia, its purifying action would remain unaltered; thus presenting, altogether, a fair opening for the investment of talent and industry. Similarly, boracic acid deserves attention, from the facility with which, even at the temperature of boiling water, it parts with the greater portion of any ammonia previously united to it, at the ordinary heat of the climate in this country. It offers, consequently, a commodious vehicle for collecting and conveying the ammonia of gas works into public use, without the risk of nuisance or loss. Many other substances possessing this double property of absorbing and giving off ammonia by a trifling change of temperature might be pointed out; but this lies beyond our province; it is the principle only which we attempt to elucidate, with a view to its practical application in some specific instance.

Presuming that the impure gas has had all its ammonia separated by proper treatment, we have now to consider in what way the carbonic acid and sulphuretted hydrogen may be most easily got rid of. Lime is the agent commonly selected; and, all things duly admitted, there is a great mass of evidence in its favor,—so much so indeed, that, until lately, it has had no competitor. At present, however, the oxide of iron is becoming a formidable rival; and therefore we propose to examine into their respective merits, which, after all, are less alike than might be supposed in two substances selected to perform one and the same operation. When properly prepared and moistened, lime removes from impure coal-gas both carbonic acid and sulphuretted hydrogen with extreme energy, and consequently effects thorough purification after the ammonia has been got rid of. Oxide of iron combines only with the sulphuretted hydrogen contained in the gas, and not with the carbonic acid; so that coal-gas purified in this way requires the subsequent application of lime, or some other material capable of combining with carbonic acid. Thus far, therefore, the advantage is much in favor of lime. But when lime has absorbed all the impurity it can attract from coal-gas, or, in technical phrase, becomes "foul," it is not only altogether useless, but, much worse than this, it is a serious nuisance, in consequence of the evolution of sulphuretted hydrogen the moment it comes in contact with atmospheric air, which arises from the action of the atmospheric carbonic acid upon the hydrosulphate of lime contained in the foul mass. Gas-lime refuse is therefore a grave inconvenience to many gas companies. Now with oxide of iron no such inconvenience is felt; for this substance, in uniting with sulphuretted hydrogen, produces a compound which yields no noxious or unhealthy emanations by contact of air, but is, under such influence, simply oxidized, and in a great measure restored to its primitive power; so that it may be used over and over again ten, twenty, or even thirty times, in succession. These peculiarities give the oxide of iron a decided superiority in many situations, though up to the present moment its practical application has been extremely limited. When lime, contained in a purifier, has ceased to purify gas, the general impression is, that it has been wholly resolved into carbonate and hydrosulphate of lime; but this is very far indeed from being the case, for even the foulest lime seldom contains less than one-fifth of all its lime free or uncombined; and gas-lime refuse is occasionally to be had so imperfectly saturated that fully one-half of the lime paid for by the gas company may be said to be thrown away. In the first place, it is not customary to examine the lime itself, so as to determine its chemical value or combining proportion; and, still worse, it is not usual, secondarily, to analyze the lime refuse with a view to ascertain how much lime is passing away unacted on. As both of these desiderata may be secured without the application of any great chemical skill, we shall proceed to give a brief description of the means needed to solve these trifling problems, beginning with the lime itself. Having selected from the bulk a fair sample of lime, let this be ground to a fine powder in a clean and dry mortar; then weigh out 100 grs. of the powder, and place it in a tumbler, or other suitable vessel, where it is to be repeatedly washed with a warm but not hot solution of sal-ammoniac in water,—the temperature being about 80° or 90° Fahr. Great care must be taken that, in washing the lime, no solid particles are allowed to escape with the ammoniacal solution; and, as soon as it is observed that the fluid containing the sal-ammoniac ceases to restore the color of reddened litmus paper, after it has been poured upon the lime, then common water may be used to wash the remaining lime; after which, it must be dried at a red heat and then weighed;—the loss will indicate the amount of pure lime present in the 100 grs. taken. This mode of analysis depends upon the fact, that lime, at the temperature indicated, decomposes muriate of ammonia and becomes soluble; but any carbonate of lime, silicate of lime, alumina, or other inactive impurity, remains behind undissolved, and may therefore have its quantity determined by the balance.

Foul gas-lime, or refuse, is somewhat more complex, but, nevertheless, far from difficult in its analysis. Having, as before, selected a fair sample, let 200 grs. be weighed out, and placed in a stoppered bottle, with an equal weight of sal-ammoniac, and four ounces of water, heated, as before, to about 80 or 90°; shake the whole well together, and keep the mixture warm for 20 minutes; then filter rapidly into a stoppered retort, and wash the filter with two ounces of hot water, which are to be added to the filtered solution. Next distil over one half of the fluid into a receiver containing 100 grs. of sulphate of copper, dissolved in water, and set the fluid remaining in the retort aside to cool. Collect the black precipitate now contained in the receiver, upon a filter, and wash it well with hot water, then dry and weigh it. It is the sulphuret of copper, and contains one-third of its weight of pure sulphur. The fluid in the retort must now be mixed with an excess of carbonate of soda, and the white precipitate which ensues well washed, dried, and then weighed. One hundred grains of this precipitate, which is carbonate of lime, indicate 56 grs. of pure lime; and if from this we deduct the quantity combined with sulphuretted hydrogen, as given by the sulphuret of copper, the remainder will be the total quantity of pure lime in the 200 grs. of gas-lime refuse, which had not been utilized in the purifier. Thus, suppose that 200 grs. of any sample in question have given 24 grs. of sulphuret of copper, and 80 of carbonate of lime, then the total amount of lime will be 44·8 grs., from which 14 grs. must be deducted for that united to sulphuretted hydrogen, since the atom of sulphur is to that of lime as 16 to 28, and 24 grs. of sulphuret of copper contain 8 grs., or one-third of its weight of copper, which is, consequently, equal to 14 grs. of pure lime. This supposed sample has therefore given 30·8 grs., or 15·4 per cent. of free lime. Thus, in place of the mere rule of thumb system, too commonly pursued in gas-works, a good gas engineer will control the entire produce of his manufactory by determining, first, the total amount of sulphur given off in a gaseous form by the coal he uses; next the chemical power of his lime; and, lastly, whether or not the action and arrangement of the purifying apparatus is such as to insure the proper saturation of the lime with the impure constituents of the coal-gas. Without the occasional employment of analytical processes, similar to those previously given, it is altogether impossible to conduct a gas-works with that certainty and confidence essential to perfect economy.

It might be supposed that, with the purification of coal-gas, the chief difficulties of a gas engineer ended, but this is very wide of the truth; for upon no point is there greater diversity of opinion, and more discrepancy in result, than exist regarding the proper mode of burning gas for the purposes of illumination and heating. As regards the former question, it seems hitherto to have been impossible of solution, from the fact that quantity and intensity of light have been confounded together; and persons have been surprised to find that a bright white light, of great intensity to the eye, has, nevertheless, illuminated a given space worse than a large quantity of a dull yellow smoky-looking light. Thus, if, when an argand oil lamp is burning with great brilliancy, the central aperture for the admission of air be closed, the flame will immediately become yellow and smoky, yet, on examining the walls of the apartment, it will be found that they are better illuminated than with the more brilliant light. In the former case many of the particles of carbon are consumed before they take on the solid condition, whereas, in the latter, they are all separated from the hydrogen of the oil, and become red-hot solid bodies ere they enter into combustion. But, as the quantity of light is proportioned to the number of solid particles heated, and its intensity to the highness of the temperature to which they are heated, it follows, that part of the carbon is employed in producing heat to give intensity of light to the remainder, in the one case, whilst in the other, the whole of the carbon becoming solid, reflects a great quantity of light of less intensity. For the ordinary wants of society the latter is the best light. A knowledge of these matters enables us easily enough to explain the vast difference in illuminating power which one and the same gas displays when consumed in different burners. Thus, a thin gas, of low specific gravity, which affords an excellent light in an argand burner, will scarcely yield any light at all with a fish-tail or bat's-wing; and a rich canal coal-gas, well adapted to either of the latter burners, requires infinite care to prevent it smoking in an argand. In determining the relative illuminating powers of different gases, it is therefore necessary to select for each gas that form of burner best suited to display its light-giving properties, and not continue the present Procrustean system of cutting down the power of the gas to an arbitrary standard of burner,—the only result of which has been a series of assertions and contradictions too disgraceful for further notice.

In photometrical experiments a spermaceti candle, of a determined size, is commonly employed, and, in a rough way, answers remarkably well. But sperm, like wax and tallow, gives quantity of light, but not of an intensity equal to gas, as may be seen in a moment by contrasting the comparatively yellow flame of the one with the brilliant white light of the other. They are therefore like musical instruments tuned to a different pitch, and can never harmonise with each other. The better plan would be to select olefiant gas as a photometrical standard, since this compound is uniform in composition, and can be easily prepared at a few minutes notice. It possesses, moreover, the advantage of being consumed in similar burners to that employed for the gas to be tested, and is under the influence of the same barometric and thermometric variations. The Bunsen photometer, as modified by Mr. A. King, of Liverpool, is, perhaps, the best instrument to employ in experiments on comparative illumination. Regarding the ultimate analysis of coal-gas little need be said, as the results have no specific value or meaning. The only correct mode of analysis is by passing a known volume of the gas over oxide of copper in a tube, heated red hot, and collecting first the moisture by chloride of calcium; secondly, the carbonic acid by hydrate of lime or solution of potash, as followed in ordinary organic analyses; and, lastly, receiving the incombustible residue over water in the pneumatic receiver: from which three products, the quantity of hydrogen, carbon, and nitrogen may be deduced. The ultimate analysis of coal-gas, as also the estimation of its value from the condensation of what is termed its olefiant gas, whether by chlorine, sulphuric or nitric acid, are processes of no practical value to the public, and serve only to mislead the ignorant.

From the vast reduction which is now taking place in the price of coal-gas, its calorific power has become one of the most interesting questions of the day; and when the waste of fuel consequent upon lighting a common fire with coal, and the loss arising out of the necessity for maintaining it, even though not wanted, are carefully inquired into, it seems very clear, that for at least four or five months of the year it is cheaper to cook by gas in London than by coal, at the existing price of these articles. An apposite illustration of the correctness of this assertion is afforded by the warm bath of Mr. Defries, in which 45 gallons of water are heated from the temperature of 50° to 100° Fahr., by 30 cubic feet of gas, and at a cost of only three half-pence. Now, to effect this at all by coal would entail an expense of at least fourpence; but to do so in the same period of time (five minutes) would certainly produce an outlay of not less than a shilling. Of course, where the operation is to be repeated, or go on continuously, a different result would ensue; but, for extemporaneous use, coal-gas will always be cheaper than coal. But even this surprising economy has been exceeded by a very elegant arrangement, invented by Mr. F. J. Evans, of Westminster, in which a coil of iron tubing is so disposed as to present an immense surface to the heating influence of the burnt gas, and thus absorb the whole of the heat. In this way a current of cold water entering at one end of the tube flows out of the other continuously and at any required temperature, according to the velocity of the current and the quantity of gas consumed in a given time. For the requirements of the Humane Society, for public hospitals and charities, a simple apparatus of this kind must find a ready application, and deserves to be better known. According to direct experiments, made with great care, Mr. Evans has found that common Newcastle coal-gas, of sp. gr. ·416, has an evaporative value equal to about 22 times its weight; or, in other words, that 1 lb. of such gas will convert, theoretically, 22 lbs. of water into steam; and this accords very well with the results given by Defries with his bath, in which 30 cubic feet of gas are stated to heat 45 gallons or 450 lbs. of water 50°. This is equal to 15 lbs. similarly heated for each cubic foot of gas, weighing, say, 206 grs., or 750 lbs. of water heated one degree by the same means. This, estimating the latent heat of steam at 960, gives 25 parts of water boiled off for every one part of gas consumed, which is very nearly three times as great as the heating power of good Newcastle coal. But practical experiments were wanting, to shew the real amount of water which can be boiled off by gas as burnt in ordinary burners beneath a boiler. This deficiency has been supplied by Mr. Evans, to whom we are indebted for the following tabular statement:—

One cubic foot of gas, weighing about—
  205 grs. and of sp. gr. ·413, boiled off $\frac{4}{10}$ths of a lb. of water, or 13·6 times its weight.

One cubic foot, weighing about—
  290 grs. and of sp. gr. ·564, boiled off $\frac{6}{10}$ths of a lb., or 12 times its weight.

One cubic foot, weighing about—
  360 grs. and of sp. gr. ·700, boiled off $\frac{7}{10}$ths of a lb., or 13·6 times its weight.

Thus shewing that, in the case of gas, one-third at least of all the heat evolved passes off unabsorbed by the boiler.

In our comments on coal, we had occasion to remark, that something like one-half of all the fuel consumed under steam-boilers is wasted; and it now appears that fully one-third of all the gas employed in our culinary operations must be thrown away, and will continue to be so until the hand of improvement is applied in the proper quarter. There is, unquestionably, much scope for ingenuity in devising the best forms of apparatus for burning gas, and utilizing its waste heat. A very elegant little machine, which promises to elucidate some difficult points in the theory of gas production, has lately been added to the ordinary testing chemicals of a gas engineer.

This consists of a bent tube, forming, as it were, the horizontal flue of a furnace, in which the products of combustion arising from gas may be condensed, and afterwards examined with reference to their nature. Mr. A. Wright, of Westminster, is the inventor and maker of the apparatus in question, and by its means two curious facts may at almost any time be demonstrated. One of these is, that sulphuric acid is an invariable product of the combustion of coal-gas; the other, that very frequently, and more especially with canal coal-gas, a substance possessing all the properties of aldehyde makes its appearance. This latter seems to be a product of imperfect combustion, and gives rise to that peculiarly offensive odour produced wherever large quantities of coal-gas are burnt in a close compartment. It is commonly believed by chemists that when coal-gas contains ammonia, this, in burning, is converted into nitrous or nitric acid; but the apparatus of Mr. Wright demonstrates at once the fallacy of this opinion, by proving that whenever gas, contaminated with ammonia, is consumed, the ammonia either passes off unchanged, or is simply decomposed into its elements; for carbonate of ammonia, and not nitrate, makes its appearance in the condensed products. Before quitting the subject of coal-gas it is necessary to say a few words upon the composition and use of what is called "ammoniacal liquor." This fluid condenses in the hydraulic main, and flows out with the tar, from which it afterwards separates by gravitation. Its specific gravity varies, as does also its composition; but the following may be regarded as a fair average:—

In one gallon, having a specific gravity of 1·017, there were found of sesquicarbonate of ammonia	5984 grs.
Hydrosulphate of ammonia	420 ,,
Muriate of ammonia	985 ,,

with traces of ferrocyanate and sulphocyanate of ammonia; consequently, if the small quantity of sulphuretted hydrogen existing in ammoniacal liquor be removed, as it may be, by the application of the requisite proportion of carbonate of lead, an ammoniacal solution will be produced, extremely well adapted for many useful purposes in the arts, such as scouring woollens, flax, and other goods, as well as for washing in general. In all these cases ammonia is greatly to be preferred to soda, even at the same price; but as the ammoniacal liquor of many gas works is actually thrown away, and under no circumstance sells for more than a farthing per gallon, it is discreditable to our industrial economy that this very obvious application of ammoniacal liquor should continue to be neglected; more especially as the fluid, even after being used, as above indicated, is still an excellent fertilising agent.

In the Great Exhibition there are but few illustrations of the manufactures peculiar to gas; a circumstance attributable to the risk of permitting the necessary experiments to take place, by which alone the actual value of any improvement in gas apparatus can be correctly determined. Hence, in the Crystal Palace, we find merely articles of established reputation, which are well known, and, having been long before the public eye, do not by any means represent the existing condition of this branch of manufacture. On this account the decision of the Executive Committee to exclude experimental gas apparatus seems somewhat unfortunate; but when the great value of the goods shewn in the Exhibition is duly considered, there cannot be two opinions concerning the propriety of the step. The various samples exhibited are, nevertheless, extremely good of their kind, both in the British and Foreign departments. In clay retorts the best specimen is in Class 27, by Cowan and Co., of Blaydon Burn, Newcastle-on-Tyne; and the next in quality may be found in the Belgian portion of the Exhibition. M. Pauwels, of Paris, exhibits a very good retort also; and there are several satisfactory-looking samples from other quarters.

MUSICAL INSTRUMENTS.

THE ORGAN.

The Organ is allowed, on all hands, to hold the first rank among musical instruments. A glance at a few of its qualities will shew that it has just claims to this pre-eminence.

In the first place, it is ennobled by the object to which it is devoted: it is the only instrument consecrated exclusively to the service of religion. Attempts have indeed occasionally been made to employ it for secular purposes, but these have generally failed; and it has always reverted to the use for which it is so eminently fitted by the solemnity and grandeur of its tones.

Secondly. It is the largest and most powerful of all musical instruments. An organ will supply the place of a full orchestra, and will support the voices of the largest chorus that can be brought together.

Thirdly. It requires the greatest amount of skill and labor in its construction, and is by far the most costly. No other musical instrument reaches the value of hundreds of pounds; a large organ is worth thousands.

Fourthly. The compass of tones in an organ is far beyond that of any other instrument, or indeed of all other instruments put together. It comprehends both extremes of the scale through which vibrations become audible as musical sounds.*

Fifthly. The organ is the most comprehensive of all instruments. The variety of tone producible from it far exceeds that which can be obtained from any other. Its loudest peals will shake the edifice in which it stands; while its softest breathings are scarcely more audible than the gentlest zephyr of a summer's eve. And between these extremes may be commanded almost every conceivable quality and combination of tone. The shrill clangour of the trumpet, the pastoral cadences of the oboe, and the smooth warblings of the flageolet,—as well as many varieties of sound which no other instrument will produce,—all come within the power of the organ.

The organ is a very ancient instrument. The word was originally applied as a general name to all instruments used to accompany the human voice;† but its use gradually became restricted to the one to which it now refers. The term occurs three times in our version of the Old Testament, viz., in Genesis iv., 21, in Job xxx., 31, and in Psalm cl., 4. The Hebrew word, in each case, is צוּגָב ; and the general opinion of commentators appears to be, that the instrument alluded to was something like the syrinx or pipe of Pan, composed of several reeds joined together;‡ we fear we must submit to the conclusion, that this and the bagpipe are the humble ancestors of the stately instrument with which we are now familiar. The *hydraulic organ,* said to have been the invention of Ctesibus of Alexandria, about 120 B. C., was extensively used by the Greeks and Romans, who employed it as well privately as in their theatres and temples. The exact nature and construction of this instrument are unknown; but there is every reason to believe that it corresponded with our present idea of an organ in many essential particulars. Organs were early introduced into Christian churches. In 757 the Emperor Constantine V. sent one to King Pepin, which was placed in the church of St. Cornelius at Compiègne. In 812 Louis-le-Débonnaire fixed one in the church of Aix-la-Chapelle, and one is mentioned as existing in the church of Westminster (the original of the Abbey), in the 10th century. At Winchester also there was an organ erected in 951, which is cited as possessing four hundred pipes, forty keys, and twenty-six bellows; the keys were very large and were struck by the fist, and two performers were required to play it. Many others are known to have been introduced about this time, and their manufacture soon began to extend. In the 12th century date the improvement of the key-board, the enclosure of several organs in one case, the use of compound stops, and the introduction of pedals, which opened a new era in the history of the instrument. A gradual course of improvement is traced in organs erected at Dijon, in the 13th century, at Halberstad, in 1360, and at Nuremberg, in 1468; about which period pipes of the large dimensions of 16 and 32 feet began to be made. The description remaining of an organ existing in the church of St. Mary Magdalene, at Breslau, in 1596, proves that, at that date, all the principal stops now employed had come into use, and that the general plan of a large organ, in all its most important particulars, had arrived at the point at which it now stands,—the only further progress made since having been in the mechanical details of the construction.

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* The lowest tone audible is generally considered to be that produced by about 32 vibrations per second (32-feet C); the highest by about 16384 (5 octaves above middle or 2-feet C), giving a range of 9 octaves. The pipes in a large organ will reach or approach both these limits.

† Organa dicuntur omnia instrumenta musicorum. Non solum istud organum dicitur quod est grande, et *inflatur follibus*, sed etiam quidquid aptatur ad cantilenam et corporeum est. Quo instrumento utitur qui cantat, organum dicitur.—*St. Augustin.*

‡ The Septuagint render the word differently in each case, viz., in Genesis by *κίθαρα*, harp;—in Job by ψαλμος, song;—in Psalm cl. by *οργανον*. The former of these renderings appears to refer to a stringed instrument; but this meaning is at variance with the ordinarily received opinion.

The tones of an organ are produced by the action of wind in pipes of different kinds and of various sizes;—the wind being supplied by bellows, and admitted to the pipes through valves opened by keys. To explain how this is effected, we must first describe the principal member or piece of construction which the organ contains, called by English builders the *sound-board.** It consists of a table or frame of wood, lying horizontally, and containing a series of closed grooves or channels, equal in number to the number of keys in the clavier, one channel corresponding to each key. The top covering of each channel is pierced with a series of holes, in which the feet of the pipes rest; so that several pipes stand over one channel, and, accordingly, answer to one note. Towards one end of every channel, on the lower side, is a long slit or opening, communicating with a box, common to all, called the

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* A great misnomer, as it has no acoustical properties whatever.

wind-chest, into which the compressed air is admitted from the bellows by a *wind-trunk.* This opening is covered by a hinged valve or *pallet*,* capable of being pulled open by machinery communicating with the key. Supposing now any key to be pressed by the finger of the performer, it opens the valve connected to it, and allows the wind to rush from the wind-chest into the corresponding channel of the sound-board, and thence into all the pipes standing over the holes pierced in its upper side. The above description, however, supposes these holes to be constantly open; but this is not so. Each orifice, conveying the wind from the channel in the sound-board to the pipe standing above it, is commanded by a narrow thin strip of wood, called a *slider;* which, having holes pierced in it corresponding to those in the channels, may, by sliding a short distance either way, be made to open or close the communications with the pipes at pleasure. The sliders run at right angles with the channels in the sound-board; and, therefore, supposing the holes in the several channels to be placed in regular lines, it is obvious that one slider will open or close, simultaneously, one hole in every channel, or, in other words, will command a series of pipes, one to each note of the organ. Such a series of pipes, if all of the same character, constitutes what is called a *stop.* The slider is connected by machinery with a rod and knob, projecting horizontally in sight, at the front of the instrument near the keys, and marked conspicuously with some inscription, designating the character of the pipes in the stop it applies to: when this apparatus, called a *draw-stop,* is pulled out, the communication is open, and the pipes of the stop will sound on touching the keys: when it is pushed in, the communication is closed and the pipes are dumb. Large organs have a great number of stops, each having its separate slider and peculiar character of pipe. The slider was invented in the 16th century; previously to its introduction each pipe had a small valve at its foot, and the opening or shutting of a whole row of these together effected what is now so much more simply done by the slider. The ancient plan is still used by Italian organ-builders.

The *bellows* now most generally used in organs are of the double kind, on the same principle as ordinary smiths' bellows, consisting of two parts, the feeder and the reservoir. The feeder, worked by manual labor, acts as a pump, drawing air from the external atmosphere, and forcing it into the reservoir; which, being weighted to a sufficient extent, keeps up a constant supply to the wind-chests of the organ. The pressure of wind ordinarily used, and which is determined by the weight laid on the reservoir, is equivalent to that of a column of water about 3 inches high, or 15 lbs. per square foot. It is customary, sometimes, to have different pressures of wind to different parts of the same organ; and some of the French builders use this plan to a considerable extent. In such cases, of course, separate bellows are required for each pressure. It is only of late that the double bellows have come into use; formerly the apparatus consisted of a series of reservoirs only, which were lifted alternately by the blower, instead of being supplied by feeders. These are still occasionally used on the continent; but the double bellows are much more convenient and efficient machines.

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* A misappropriation of the French word *palette*, which refers to another portion of the machinery.

The pipes of an organ are of two classes, producing their sound by entirely different means; these are *flute-pipes** and *reeds*.

Flute-pipes produce their tone on the same acoustical principle as the German flute, the flageolet, or the common whistle; namely, by causing a thin stream of air, issuing from a narrow opening, to impinge upon a sharp-edged blade of some solid material, whereby a column of air contained in a tube is set in vibration, and made to produce musical sounds. Flute-pipes are made either of metal or of wood. The form of a metal pipe, speaking on this principle, must be familiar to everybody who has seen the front of an organ, where rows of such pipes usually decorate the exterior of the case. Three principal parts will be noticed:—the foot, the mouth, and the tube. The foot is of a conical shape, and has no function further than to receive the wind from the hole underneath, and to convey it to the mouth. At the top of the foot, and close underneath the mouth, is fixed a horizontal division or septum, called the "*languid*;"† it extends across the pipe, leaving only a narrow slit open in front, through which a thin sheet of wind rises, in such a direction as to impinge immediately upon the upper lip of the mouth. Part of the wind escapes at the mouth; the remainder enters the cylindrical part or tube of the pipe, above, and vibrating therein gives the tone. Wood pipes are similar in their essential construction to those in metal; but their tubes are square instead of circular in their section, and the foot is differently contrived. Pipes of the flute kind may be either *open* at the top of the tube, or may be *stopped* with a plug, which alters the pitch, as will be hereafter explained. The majority of pipes used in an organ are open and made in metal; the stopped kind are generally of wood.

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* By one of the many ridiculous misnomers that have crept into English organ nomenclature, this appellation has been corrupted into "*flue*" pipes. The French call this class *tuyaux-à-bouche*, or *jeux de flûte*; the Germans, *Flötenwerk*. Reed stops are called in French *jeux d'anche*; in German, *Schnarrwerk*.

† Another absurd misnomer, being a corruption of the French word *languette*, which, however, means quite a different thing, the tongue of the reed.

The pitch of the note spoken by a flute-pipe depends on the length of the pipe above the mouth, and follows the simple geometrical law, that doubling the length makes a pipe speak an octave lower (by doubling the length of the vibrating columns of air),—or, *vice versâ*, halving the length makes it speak an octave higher. It is found, by experiment, that an open pipe, about eight feet long, will speak the C forming the lowest note of the violoncello, or the note produced by about 128 vibrations per second; and hence we have the following scale:—

No. of Vibrations per Second.	Note.	Length of Open Pipe.
2048	C in alt.	½ foot
1024	The C, on the 3rd space in the treble clef	1 "
512	The C called middle C; the note of the C clef	2 feet
256	The C called tenor C; the lowest note of the viola	4 "
128	The lowest note of the violoncello	8 "
64	The lowest C of a grand piano-forte	16 "
32	The C below	32 "

It is useful to bear this scale in mind, as it affords a key to the arrangement and nomenclature of the various stops, as will be hereafter explained. Moreover, it is now very customary to express the notes by the lengths of pipes corresponding to them: for example, the lowest C of a grand piano-forte is often called 16-feet C; middle C is called 2-feet C; and so on.*

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* Some explanation is necessary, to prevent misunderstanding, in reference to this scale.

In the first place, the number of vibrations is approximately that of the old church pitch; the modern orchestral pitch is considerably higher.

In the case of a string, the numbers in the table refer to *single* vibrations, not to *complete* or *double* ones. The latter are used by some writers on harmonics, and the difference, if not explained, would create confusion. The former are evidently the most correct, as indicating the number of distinct impulses given to the air, and corresponding with the oscillations

The above scale refers to *open* pipes; when they are *stopped* at the top, a remarkable change occurs, the effect being to cause them to speak an octave lower. Thus, a stopped pipe, 8 feet long, will speak the same note as an open one of 16 feet; a stopped pipe, 2 feet long, will speak the note of an open one of 4 feet; and so on. The reason of this is, that, as the air cannot get out at the top of the pipe, it returns, and makes its exit at the mouth; the effect of which is to double the length of the vibrating column, and so to make its vibration proportionately slower.*

The *quality* of the tone of a flute-pipe depends principally on the *scale,* and the *voicing* of the pipe, and sometimes on slight peculiarities in its form or construction. By the scale of a pipe is meant the proportion which the diameter of the tube bears to its length; if the diameter is large, the pipe is said to be of a large scale, and will have a powerful and full tone;—if small, it is a small scale, and the tone will be thinner and softer. The scale of the principal stops of an organ should be, therefore, always adapted to the size of the building it is intended for; while the use of different scales in the same organ gives the means of producing stops of diversified tone. The principal element, however, in producing the quality of tone, is what is called the "*voicing;*" it consists in the careful formation of the mouth of the pipe and parts adjacent, and the regulation of the quantity of wind it shall receive, by opening or closing the hole at the bottom of its conical foot. It is a most delicate operation, requiring the greatest skill on the part of the operator.

Many of the pipes for the lower notes are too large to stand

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of a pendulum.—See Chladni's elaborate work, "Die Akustik," Leipzig, 1830.

The number of vibrations corresponding to any given note is indicated by a very ingenious instrument, invented by Baron Cagniard de la Tour, and called the *sirène.* It may also be calculated as follows:—Stretch a wire (a piano-forte wire, for example) over two rests, and tighten it by a weight till it sounds the given note. Let l represent the length in inches, and w the weight in lbs., of the vibrating part of the wire; also, let T represent the tension, or stretching weight, in lbs., and V the number of *single* vibrations per second. Then,

$$V^2 = 386{\cdot}156\,\frac{T}{lw}.$$

The relation between the sound of any note and the corresponding length of pipe is as follows:—Let L represent the length of the tube part of the pipe, above the mouth, in feet, and V the number of vibrations per second corresponding to the given note. Then, approximately,

$$V = \frac{1024}{L}.\ \text{or}\ L = \frac{1024}{V}.$$

* A stop consisting of stopped pipes, is called, in French, a *bourdon;* in German, *Gedact.*

over their proper holes in the sound-board. In this case they are fixed in convenient places, at some distance, and the wind is conveyed to them from the sound-board by tubes. It is customary also to place rows of pipes in front of the case, and these are supplied with wind in like manner. These ranges of front pipes constitute what is called in France the *montre;* and, in Germany, the stop to which they belong is called the *principal.*

The metal principally used for the construction of flute-pipes, on the continent, is pure tin; in England, it is a base mixture of tin and lead. The former is more expensive, but it is very much superior, being more durable, and giving a more brilliant quality of tone.

The other great class of organ-pipes are the *reeds.* The sound of these is produced on the same principle as that of the clarionet and the bassoon, namely, by the vibrations of a thin tongue of some elastic material, put in motion by the wind. A reed pipe consists of three parts,—the foot, the reed apparatus, and the tube. The foot receives the wind; it is a sort of box, into the upper part of which is inserted the end of the pipe tube, having the reed apparatus attached. This consists of a small brass tube, having one flat side, in which an oblong slit is made; this slit is covered by a tongue or leaf of thin hard brass, fixed at one end, and left free to vibrate for the remainder of its length. The compressed air surrounds the whole, and tends to press the tongue flat down upon the slit and close it like a valve, which it would do if the tongue were perfectly flat; but it is slightly curved, so as to allow the free end to stand, by the natural spring of the metal, a little off the face of the tube. The wind rushing through the opening thus left, presses the tongue momentarily down, but it is immediately raised again by its elasticity; the quick repetition of this alternate action causes it to beat against the face of the tube in a continual succession of vibrations. Every time that the tongue rises, a portion of wind escapes through the opening, and enters the tube of the pipe fixed above, and communicating with the small tube of the reed; and it is to the vibrations caused by the pulsations of air thus following each other in quick succession, that the sound is ascribed,—the tongue being merely the instrument of producing them. The pitch of the note sounded by a reed-pipe is determined by the length, the thickness, and the elasticity of the brass tongue, and not by the length of the tube.

The tube of the reed-pipe, however, materially affects the quality of the tone. It is imperative that it should be made such a size that the vibrations of the column of air it contains exactly correspond with those given by the reed. When thus arranged it acts in the same manner as a speaking-trumpet does to the voice, rendering the tone more full and powerful. The diameter and form of the tube also influence the quality; and, by variations in these particulars, different varieties of reed-stops are obtained. The tone of reed-stops, in general, is of a sharp cutting character: they add considerably to the brilliancy and power of the organ, and in their more delicate varieties form agreeable stops for solo or fancy performance. The tubes of the reed-pipes are, in England, formed of the ordinary pipe-metal, lead and tin; but, on the continent, those of the principal stops are made of pure tin. For this reason, and also on account of the greater importance assigned to this department of the organ in French instruments, our neighbours excel us in the brilliancy and effect of their reeds. The tubes of some of the largest reed-pipes are often made of wood, to save expense.

Having now described the pipes individually, we proceed to explain how they are used collectively in the form of stops. A stop is a range of pipes, of the same character of tone, extending throughout the compass of the organ, generally one to each note; so that if a certain stop is drawn, the keys will play throughout on pipes of that character of which the stop consists.* Large organs contain a great variety of stops, nearly all differing, in some respects, from each other; but we may simplify the description of them by remarking, that the character of every stop depends on two elements, namely, its pitch and its quality of tone.

Stops are of different *pitch*, *i. e.*, the same key will sound different notes, according as different stops are drawn. There are two modes of designating the pitch of a stop,—the English and the continental mode. The mode which, for the sake of distinction, we call the English (although, in reality, it is but partially adopted in this country), is by stating the interval which any note of the given stop makes with the fundamental note, corresponding to the key struck. Thus, when the key middle C (2-feet C) is struck, a certain stop will sound the G, at an interval of a twelfth above; this stop is therefore called the "twelfth." Another stop will sound the C two octaves above, and is therefore called the "fifteenth." The stops which sound the fundamental note itself would be on this principle designated "unison," and those sounding an octave above it would be called "octave." For the stops sounding an octave below the fundamental note the word "double" has been used, and, though not correct in principle, it may be considered as sanctioned by custom.

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* The unmeaning and unsystematic nomenclature of organ stops, which has gradually crept into use, has become the subject of great complaint. The names attached to the stops, instead of serving to guide to their use, only tend to perplex the player, and to produce confusion and misunderstanding

To explain how the pitch is designated in continental organs, we must premise that the lowest note of the organ manual claviers is always supposed to be, and in well designed large organs always is, the note C corresponding with the lowest note of the violoncello. This being understood, the pitch of a stop is expressed by defining the note which that particular stop speaks to the lowest key of the organ manual; and the way adopted of defining this note is by giving its corresponding length of pipe (supposing it to be of the open flute kind), according to the table in page 106. A few examples will make this clear. The stop called "diapason" by English organ-builders, and which speaks 8-feet C to the lowest note of the manual, is called an 8-feet stop, as are all those that speak in unison with it. Stops of this pitch are the most important in the instrument, as they give the same sound as that represented by the key struck. Stops which speak an octave lower than these, giving 16-feet C to the lowest note, are called 16-feet stops. Those speaking an octave higher, giving C or 4-feet C to the lowest note, are called 4-feet stops, and so on.*

The tone of every key in a large organ consists of notes of many different pitches combined, so as to blend together, and to give the effect of one sound. The first organs consisted of the fundamental note only, or what would now be called the 8-feet or unison stop; and, doubtless, the first attempts to increase the power were by sounding several of these together; but it must soon have been discovered that the accumulation of sounds of the same kind, vibrating in unison, did not produce any thing like a corresponding increase of effect; and therefore it became necessary to resort to some other expedient for attaining the wished for end. The addition of a pipe sounding the octave above, or a 4-feet stop, was probably the first effort in this direction, and was followed by the further addition of the fifteenth (2-feet), by which a powerful and brilliant effect was gained. At length it appears to have been discovered, that in certain sounds, of which that of a bell is a good example, other notes were heard beside the fundamental one, forming what are called harmonic intervals with it; and yet the whole combining into one powerful single tone. This suggested a means of further increasing the power of the organ; and, accordingly, a pipe, speaking the *twelfth* of the fundamental note (a 2⅔-feet stop), was added, which gave additional power and mellowness to the tone. This combination of four stops, viz., the fundamental note (8 feet), its octave (4 feet), its twelfth (2⅔ feet), and fifteenth (2 feet), forms a tolerable organ, and is often used when only a moderate degree of power is required. Further extensions of the principle were, however, found to be necessary for large buildings, and then arose the "compound" stops, consisting of various combinations of the intervals of the major common chord, or 3rd, 5th, and 8th, in octaves above the fifteenth, giving a peculiar brilliancy to the whole combined sound. Here, however, arose a difficulty;—in proportion as the compound stops or "mixtures" were increased, and carried higher in the scale, it was found that the whole sound had a tendency to become too shrill, and wanted weight at the bottom; and since, for reasons already explained, it was of little use to augment the number of pipes speaking the fundamental note, the plan was felicitously hit upon of adding the octave below, called the "double" or 16-feet stop. This last addition has been the salvation of large organs; without it a tone, at once brilliant and powerful, and suited for large edifices, could not have been obtained. It not only added, in the most effective manner, the weight necessary to balance a bright combination of mixtures, but has allowed of several intervals being inserted which could not otherwise have been used; viz., the fifth (5⅓ feet) and tenth (3⅕ feet) of the fundamental note. One or two bold makers have added the interval of the flat seventh, which exists in nature, and may, with great caution, be made to combine with the sound. In some of the largest French organs, and in one English one (St. Olave's, Southwark, designed by Dr. Gauntlett), a 32-feet stop, speaking two octaves below the fundamental note, has been used. The small compound stops are generally so arranged that one draw-stop serves for several ranges of pipes, and hence a compound stop is said to consist of 2, 3, 4, 5, or 7, ranks, as the case may be.

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* The foreign mode of designating the pitch of a stop has been much misunderstood and misapplied in England. For example, 8-feet or unison stops have been called 4-feet when they consisted of *stopped* pipes, because their longest pipe was only that length,—the makers losing sight of the principle that the designation applies to the *note sounded*, and not to the actual length of pipe producing it. Again, when the organ manual extended a few notes lower than the orthodox limit, an 8-feet stop has been called a 10 or 12-feet; or, if an octave lower, a 16-feet. Other mistakes, equally at variance with the principle, have been made.

An idea may now be formed of how the tone, in a large organ, is produced. On touching any key it sounds not only the note proper to it, but also several octaves of it, above and below; and, in addition to these, several repetitions of the harmonic intervals forming its common chord. Yet, when these sounds are correctly balanced and adjusted to each other, the entire effect is but that of one note, the fundamental one, endowed, however, with a body and a brilliancy that could be obtained by no other means. We need scarcely add, that the adjustment of the stops to each other, is one of those operations in which an organ-builder's knowledge, experience, and skill are most required.

The "reeds" form a considerable reinforcement to the power of the full organ. They are used in the form of 16 feet (double), 8 feet (unison), 4 feet (octave), and sometimes 2 feet (fifteenth) stops. The former of these, though very common in organs of moderate size abroad, and one of the most effective in adding power and weight to the tone, has been hitherto but little used in this country.

Besides the above-mentioned stops, which compose what is called the "full organ," there are many others of peculiar quality of tone, called "solo" or "fancy" stops. They are generally either 8 feet or 4 feet in pitch, but principally the former; and they are made both of the flute and the reed kind. The variety is given in the flute stops by the scale, the material or the form of the pipe, and by the voicing. Wood pipes, whether open or stopped, produce a more subdued tone than metal; and this may be much modified by alterations in the mouth and different modes of voicing. A favorite kind of flute solo stop is made by so voicing an open wood pipe as to give a soft reedy quality of tone. A stopped metal pipe, with a hole through the stopper, prolonged by a small tube above, and called by the French *flûte à cheminée*, gives a clear mellow tone. The delicate silvery sound of the stop called the "dulceana," is produced by an open metal pipe, of very small scale; and an agreeable kind of tone has been lately obtained by a pipe pierced with a hole in its side. A fine stop, used by the French, is produced by making the pipes "overblow," as it is called, so as to sound an octave higher than the note due to their length.

Among the reeds, varieties in quality are produced principally by varying the form of the tube. The ordinary tube is conical; that of the stop called the oboe has a bell mouth;

and a parallel tube gives a tone much resembling a clarionet. The so-called *vox humana* is usually a variety of reed-stop.*

The continental organ builders, particularly the Italians, are greatly in advance of the English in the number, variety, and beauty of their solo stops; indeed it is only within these last few years that any attention has been paid to them in this country.

In a large organ, containing a great variety of stops, it is found advisable, for the convenience of the performer, not to make the whole of these playable by one key-board, but to distribute them upon several. The instrument then consists of two, three, or more organs, entirely distinct from each other, each having its own sound-board, stops, and clavier,—the claviers being placed one over the other, conveniently for the performer to play on which he pleases. In addition to these, there is also a separate organ, with a key-board to be played upon by the feet, and called the "pedal organ." The arrangement and number of these organs varies in different countries, and in different sized instruments. No organ of any pretensions should have less than two claviers; and all large ones have three, exclusive of the pedals. We shall take an organ of this class for description.

The most important of the three manuals is called the "great organ;" it contains the principal stops for giving power; and its keyboard is generally the lowest but one. The compass is, 4 octaves in old and 4½ octaves in modern organs, beginning with C (8 feet) as the lowest note. In France, the principal reed-stops, and some other powerful stops, are made into a separate organ, receiving a different pressure of wind. Its clavier, called the *clavier de bombarde*, is immediately above that of the *grande orgue*, and is capable of being coupled with it, that they may be played together.

The lowest row of keys generally belongs to an organ of smaller size, called on the continent the *positif*, and in England the "choir organ." It is often placed in a separate case in front of the larger one, and contains stops of a light character, and solo-stops. Its compass is the same as that of the great organ.

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* The *vox humana* stop has been a favorite theme for sentimental tourists and book-makers, who, ignorant enough of the subject, have undertaken to eulogize foreign organs, and absurd stories have been promulgated about its being mistaken for a choir, &c. All this is pure imagination. The stop bearing this name is, in most cases, little or nothing like what it professes to represent, but a disagreeable nasal snarl, of which any street ballad singer would be ashamed. It is much less like the tone of the human voice than a good open flute pipe of the ordinary quality. The English *vox humana* is a reed with a double cone at the top of the pipe;—the French *voix humaine* has a cylindrical tube, partly closed at the top. The Italian *voce umana* is of a different kind altogether, being composed of two *flute* pipes of a thin quality, one tuned a little flatter than the other, so as to give a tremulous tone like that produced by a good singer, or a skilful player on the violin. This latter kind of stop has also been called *voix céleste* and *unda maris*; its effect is agreeable when judiciously made.

The organ to which the upper clavier belongs, is called in England the "swell," and consists of an organ shut up in a box closed on three sides, but furnished in front with Venetian shutters, or moveable louvre boards, made to open and close by means of a pedal. When they are shut, the sound of the enclosed organ is muffled and distant; but, on putting down the pedal, they are gradually opened, and the sound becomes louder. The swell thus gives what the instrument would not otherwise possess, viz., the power of *crescendo* and *diminuendo*; and, when this organ is large, the effects producible are exceedingly fine. The swell is an English invention; but by whom or when introduced, we cannot learn. It is not much used abroad. The swell contains the same kind of stops as the great organ, but usually on a smaller scale. The compass in large organs is the same as the other claviers; but stopped pipes are used for the lower notes, in order to save room.

The pedal organ is played by the feet,—the keys being of a convenient size for the purpose.* The compass is usually 2¼ or 2½ octaves, beginning with C as the lowest note. The stops are 32-feet stops, of the flute kind, in metal or wood, or both, with 16-feet, 8-feet, and smaller sizes, as in the great organ; also 32-feet, 16-feet, 8-feet, and 4-feet reeds. In organs of small size, the 32-feet stops are not found. In England, few organs have any large separate pedal organ; but the pedals are made to pull down the keys of the great organ, having, in addition, one or two sets of 16-feet pipes, called "pedal pipes." The large organ at St. Paul's, Frankfort, has two separate pedal claviers, each playing distinct pedal organs.

The organ contains some mechanical contrivances, which add considerably to its effectiveness, and which it is necessary therefore to explain.

Among the foremost of these rank what are called *couplers*, *i. e.*, movements, by the aid of which, different sets of keys may be made to act on each other, or be coupled together,—the object being to give additional power and variety. A large organ has generally couplers by which the great organ may be made to play all the others, so as to put the power of the entire organ together; or the claviers may be otherwise united together in pairs, by which increased variety in the mixture of stops is attained. Another kind of coupler is that which causes any key to pull down its octave above or below, by which great increase of effect is obtained; these are more common in foreign than in English organs, and in Italy this kind of mechanism is called the *terza mano*, or third hand. The couplers are made to act by draw-stops, projecting at the front of the instrument, or sometimes by pedals. The latter plan is generally adopted in France.

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* Great inconvenience arises from different dimensions of the pedal clavier being adopted by different makers. We heard a celebrated German organ player and writer, while playing lately on some of the organs in the Exhibition, express himself strongly both on this point and on that of the nomenclature of the stops.

Another mechanical contrivance is that of pedals for opening and shutting the stops. It became obvious, at an early period, that it would be convenient to effect, while playing, certain changes in the disposition of the stops, without using the hands for that purpose; and the first contrivance of this nature was a pedal, to take off the loud stops only. This was called the "shifting movement," but its use was very limited, and it was superseded by the present arrangement of "composition pedals." There are a series of pedals, to each of which corresponds a certain given combination or "composition" of stops, and which, on being pressed down, will ensure this combination of stops being drawn, no matter what was drawn before; it will push in those stops that do not belong to its own combination, and will pull out those that do; thus, a certain pedal will always give the full organ, a certain other one the 8-feet stops only, and so on. The composition pedals were invented by Mr. Bishop, the English organ builder, in 1800, and are now very generally used. Some of the organs in the Exhibition have new contrivances for acting on the stops, which will be noticed in the proper place.

Mr. Bishop has also contrived a means, which he terms an "anti-concussion apparatus," for remedying the pulsation or concussion of air in the wind-chest, when a large number of pipes suddenly cease speaking, and but a few are held on. It consists of a small reservoir, communicating with the wind trunk, and pressed down by a spring, so adjusted as to balance exactly the ordinary pressure of wind. When, therefore, the main reservoir is suddenly stopped, and a momentary extra-compression of the air is thereby caused, the anti-concussion spring gives way, and the pulsation of wind lifts the small reservoir, instead of expending its force on the pipes that are speaking. This apparatus was applied to the organ in St. Paul's Cathedral, in 1828.

The ingenuity of organ-builders has been exercised also in contrivances for lightening the touch. In large organs, the valves or pallets, for admitting the wind to the channels in the sound-board, require to be of large size, particularly for the lower notes, and the pressure of wind upon them is therefore very considerable. This pressure having to be overcome by the fingers, whenever the valve is opened, one of two evils must ensue; either the touch must be very heavy, or a limit must be put to the size of the valve and the pressure of wind used. The first alternative renders the organ difficult to play; the second is unfavorable to its perfection, and forms a bar to all improvements in which a greater force or quantity of wind is required. Several attempts have been made to remedy this; and the Exhibition affords examples of some successful contrivances directed to this end, the peculiarities of which will be hereafter described.

Some foreign organs have an apparatus called the *tremblant* or *tremolo,* for producing a trembling or shaking effect in the sound; but its use scarcely appears legitimate, and it is almost discarded. The effect is produced by a valve being placed in the wind-trunk, in such a manner as to communicate vibration or pulsation to the wind as it passes along.

DECORATIVE ART.

It is in the early ages of christianity, in the twilight of time (to use the happy expression of a modern writer), that we must seek for the origin of glass painting,—an art that arose under the influence of the same religious enthusiasm from which our early christian architecture may be said to have sprung. From the earliest time, stained glass windows were, no doubt, employed, as at present, chiefly in the decoration of buildings devoted to the purposes of religion; and, surely, never was decoration more suitable, in every respect, to its object; the beauty and brilliancy of the colors, the sparkling gem-like effects of which they were susceptible, when skilfully combined, gave, at little cost, an enduring richness to the architecture, and created a characteristic atmosphere of light which spoke unmistakably to the beholder of the sacredness of the building thus decorated. Although as early as the fourth or fifth centuries of the christian era we find traces of the employment of colored glass in the decoration of the windows of ecclesiastical buildings—there exists, we believe, no authentic mention of any particular edifice so ornamented previously to the seventh century; at that period, however, when the magnificent Byzantine Church of St. Sophia was re-constructed, after having been destroyed by fire, it is said that its windows were ornamented with mosaics in colored glass; about the same time also, according to the venerable Bede, foreign artists were brought into England by the Bishop of Wearmouth, for the purpose of constructing windows of stained glass in the abbey of that name. As there are now, however, no remains of stained glass which can be traced to an earlier period than the twelfth century, it is at that time, properly speaking, that any considerations relating to this subject, ought to commence; for there are still in existence so many undoubted examples of the stained glass of that epoch that there all uncertainty and hypothesis, in reference to this art, must vanish.

In the first applications of colored glass to the decoration of windows, it was probably employed in the character of mosaic, relieving, by its brilliancy, the dull uniformity of tint and effect produced by the colorless glass. Gradually and naturally the artist would pass to the development of a design in which we should expect that, in the first instance, nothing beyond the symmetrical and harmonious arrangement of colors would be attempted,—a simple geometrical, or, at least, uniform pattern, being the result. From this, as naturally, the artist would take another step, and introduce something like pictorial design. If we examine the specimens of the most ancient stained glass, we shall perceive at once that a course, similar to the above, was certainly followed, although, perhaps, to some degree unconsciously, by the glass painter. The leading feature of the stained glass of the twelfth century was its decorated ground work and rich borders,—medallions, containing the pictorial designs, being laid upon the ground in the character of a thing added, and being, as it were, subservient to the original design. About the time when gothic architecture had reached its culminating point, the art of glass staining was likewise in its highest stage of development; and although some writers have considered that glass painting had attained its greatest perfection in the fifteenth and sixteenth centuries, when a higher style of art had been wedded to the more technical efforts of the older artists, our conviction is, that the period at which glass staining had reached its full vigour—when its whole capabilities were made to display themselves—was that in which it most truly played the part of a decoration, in keeping with and subservient to the feeling of the architecture of the edifice in general, and before it was forced into a kind of separate or individual existence, to which, as we shall shew, it is in many respects unsuited. In the stained glass of the twelfth and thirteenth centuries, its leading characteristics are elegance and grace of form and harmony of color; and although in the works of this period pictorial representations are found in the form of medallions, yet, in the drawing of the figures and the color of the accessories, it is evident that only one object fixed the attention of the artist, namely, to produce an ensemble, in which harmony of color and not correctness of design, was the principal point to be attained. Some writers upon this subject have believed, apparently upon slender grounds, that in ancient glass painting the colors severally possessed a special signification; and that their combinations, like those of heraldry, were symbolical of some particular sentiment. This appears to be seeking for a difficulty where none really exists. That the early glass painters were thoroughly conversant with the principles of harmony in coloring, their works bear ample testimony. The palette of the artist of the period was, however, comparatively poor; and in producing an object in which color was the leading feature, it is not surprising that the artist should bend his whole strength to the task of rendering that feature as perfect as possible: so, when the necessities of the case required it, the natural color of objects, in their pictorial designs, was totally disregarded,—that color being introduced which best conduced to the general effect of the decoration, without reference to truthful representation. In ancient glass, we have many striking examples of the disregard of natural effects, which incontrovertibly prove that the design was a matter of secondary consideration, and that harmony of color was the great end of the whole work. It is not surprising that a certain degree of similarity in the manner of expression should exist between the herald painter and glass painter,—their respective subjects probably originated at about the same period; and in the mere conventional representation of objects we should expect that a somewhat similar mode of treatment would be found. At the same time there does not appear to be any ground for believing that the old glass painters employed their color otherwise than in its common acceptation, using it merely with reference to the effect of the decoration, and without any hidden or mysterious signification.

A kind of inspiration seems to have guided the earlier glass painters; for although in later ages artists of the greatest excellence lent their assistance to this branch of art, still in proportion as fine art became united to it, it lost those normal characteristics which, above all, rendered it suitable to its purpose. It is not improbable that, in some respects, the very imperfections of the material with which they worked gave a certain degree of advantage to the early artists in obtaining some of the effects of stained glass. The art of glass-making was then in its very infancy, the methods of manufacture were rude and imperfect, and the glass produced was irregular in thickness, and filled with striæ and other defects. The thickness, the irregularity of surface, and the coarseness of texture, may possibly, however, have tended to give a peculiar grain and character to the work, which would increase its effect, particularly when viewed from a distance. A comparison between the process of line engraving and mezzotint will illustrate our meaning. To what does the former owe its superior brilliancy and clearness of tone? Simply to the circumstance that instead of its effects being produced by smooth gradations of color, they are the result of the crossing and re-crossing of black lines upon a light ground. In some specimens of early red glass a similar peculiarity may be seen. The color, instead of being uniform, is striated and irregular, and from a distance a much better effect may perhaps be obtained from color, so displayed, than when the tint is perfectly uniform. The early art of glass painting is generally supposed to have depended for success upon some secret processes, long since entirely lost. Nothing can be more fallacious than this belief:—it is true that at a certain period stained glass fell into disuse, at least in great measure, and the prosecution of the art perhaps ceased to be regarded with that degree of consideration necessary to its support. The cause of its gradual decay must, however, be sought in other circumstances than the loss of the knowledge of secret technical processes: it must, in considering this subject, be borne in mind, that between the painting of pictures and the execution of a stained glass window, there exist but few points of relationship. The art of glass painting was originally strictly an art decorative; or, perhaps, we may say with more correctness, a monumental art; it took, as we have already said, its rise with Christian architecture, and it formed a part of that architecture, and was in perfect subordination to the architect's design. Whilst this connection continued, glass painting flourished in all its glory and strength; but gradually there arose a desire to disunite the two—to raise that which was a mere decoration, and which, in that capacity, was incomparably suitable to its object, into the rank of the fine arts: the consequence was, that from the moment of its separation from architecture, glass painting decayed. So far from early glass painters possessing any superior technical processes, as is generally supposed, it is probable that they were far behind those of the present day in this respect: they possessed but few tints of color in glass; and the art of enamelling, so as to fix the colors, applied in the progress of the work, was imperfectly, if at all, known to them. Their colors were limited to ruby, blue, violet, yellow, and green; they had no means of producing the intermediate shades of color, which can now be obtained so successfully that the palette of the glass painter is furnished with every variety of tint; yet with these limited means what wondrous effects did they produce! To those of our readers who desire to see what can be done at the present time by manufacturers of colored glass, and to judge accordingly of the advantages possessed by modern glass painters, we recommend the examination of the edging or border of a piece of glass staining, of a rose shape, placed in the Exhibition (North Gallery) by Messrs. Chance, of Birmingham. The border consists only of pieces of colored glass, without any design; but the glass is of every conceivable tint,—a beautiful ruby, among others, equal to the finest ancient ruby, the art of making which was indeed lost, and we believe re-discovered only a few years since by a French manufacturer residing near Paris.

In the early stained glass, the faces and hands of the figures were always executed in a greyish-brown kind of glass, without any attempt at color; the features and markings being traced out with black; and the shadows being also sometimes hatched in black lines. The color in which the lines were thus traced, although probably in some degree fixed by the application of heat, still held so imperfectly to the glass, that in some specimens it may be removed with the finger nail. When the art of enamelling the colors on glass came to be better understood, the artists ceased to retain one of the peculiar characteristics of the early glass, viz., the beautiful azure or ruby backgrounds, which are to be seen in almost every specimen of the stained glass of the twelfth or thirteenth centuries. The power of fixing applied colors by the furnace, gave the artist the means of producing more elaborate designs and enrichments of his work; but at the same time it tended to promote those attempts at the introduction of a higher art, which ultimately led to the destruction of glass painting in its legitimate application. The art of glass painting (improperly so called perhaps) consisted in nothing more than arranging in certain order, according to a cartoon prepared before hand, slips of glass of various colors, cut into the proper shape by means of a hot iron,—the use of the diamond being at this period unknown; and the only part of the process bearing any resemblance to fine art was the tracing out the features, and roughly hatching in the shadows. In some of the stained windows of the twelfth and thirteenth centuries, we find the backgrounds formed of a greenish-white glass, hatched with black lines,—colored glass being somewhat sparingly introduced. In the celebrated window in the north transept of York Minster, called the Four Sisters, we have an example of this style. This noble window, the lancets of which are 50 feet high by 5 wide, was made in the year 1227; it is perhaps the finest specimen of early glass painting extant in England. Copies of portions of this window may be seen in the Exhibition (north gallery), which give an excellent idea of the peculiarities of the original: they are by Wailes, of Newcastle-upon-Tyne. There are other good examples of the early style of glass staining, exhibited by Chance & Co., and Powell & Sons, of Whitefriars; the painting being by Rees, and by Holland, of Warwick.

Before the expiration of the thirteenth century, the practice of converting stained glass windows into pictures had commenced: at that time, we first find figures of large size introduced, but they were still in the monumental style. In the fourteenth and fifteenth centuries, the tendency to amalgamate fine art with decoration continued to progress; a higher degree of finish, an attempt to imitate nature more closely, could now be discovered. In many cases, the faces and hands were more or less colored,—the hair in almost every instance; and, as the glass stainers had learned the art of enamelling their colors, pictorial backgrounds and rich costumes had become a leading feature. What is termed the canopied style was now also introduced; in a rude form this will be seen likewise in some remains of the thirteenth century; but, at a later epoch, its use became general. It consisted in the introduction of architectural canopies above the isolated figures, which, consequently, stood, as it were, in a kind of niche; the figures were also executed in a higher style of art, and had acquired a kind of individuality. The general decoration of the window was now secondary to the figure,—the whole taking, more or less, the character of a picture. Another peculiarity of the fourteenth century, was the employment of beautiful ornamental rose-shaped medallions, laid, as it were, upon the background of the window, which was now more elaborate in design than in the preceding century; but it is curious to remark, that, while the tendency was altogether towards the employment of a greater profusion of ornament, and the most vivid contrasts of color, another innovation arose, quite in a contrary direction; this was in the use of a greenish-grey tinted glass, termed by the French glass stainers *grisaille*. This was employed as a background; and the designs were traced upon it either in color or in black only. The *grisaille* came, at a later period, to be often used for figures and certain specific portions of the work,—the remainder being filled up with colored glass, as heretofore. It is remarkable that, in an age in which so much feeling for color evidently existed, the sudden transition to the use of a material similar to the *grisaille* should have taken place. By some it has been supposed that this arose from its being less costly than the stained glass; by others that it was substituted for the latter on account of its permitting of the passage of more light. Be this as it may, the fact of its general introduction at this period is undoubted. In the cathedrals of Salisbury, Lincoln, and Wells, specimens of *grisaille* are still remaining; but probably the best specimen of the general style of the fourteenth century is the eastern window of Bristol cathedral. In the fifteenth century stained glass began to be employed in secular buildings as well as in churches, and the original characteristics of the art were fast vanishing; its strictly decorative and mosaic style had been replaced by one foreign and unsuitable to it, and the decay of glass painting, as a specific art, was in its advent. Fine art had usurped the place of decorative art, but with what result, the subsequent history of glass painting will best portray. During the fifteenth century, however, some fine works were executed,—for the art still maintained some of that monumental style to which it is so peculiarly suited.—At this period was constructed the great east window of York Minster: this was begun in 1405, by John Thornton, of Coventry. It must be considered one of the most remarkable specimens of ancient stained glass, both with regard to its magnitude, the variety of the subject, and the beauty and harmony of the colors. Glass painting came now to differ only in the material in which the work was executed, from the mural paintings of the period; for the great aim of the artist was to imitate nature. What is termed the period of the Renaissance was that of the decadence of the noble architecture which had produced those cathedrals, whose grandeur and beauty have never been equalled,—and glass painting followed in the train of architecture.

As a medium for the interpretation of fine art, glass is essentially unsuitable; whereas it would be, we believe, impossible to conceive a material better adapted to the mosaic style of decoration. The effects of colored glass are those of the colors of the prism: it is so difficult to kill this brilliancy, that in attempts to paint or enamel pictorial effects on glass, there always remain a degree of transparency, glare, and flimsiness (if we may use such an expression), entirely destructive of any close resemblance to nature. In the Exhibition, at the present moment, are placed in juxtaposition numerous specimens of glass painting, in different styles, comprehending all periods. If we study their peculiarities closely, compare picture with decoration, the Five Sisters of York, and other examples of the early ages, with some of the objectless and inconsistent mixtures of the nineteenth century,—there can, we believe, be but one deduction made from such a comparison. In the nave is exhibited a grand specimen of glass enamelling by an Italian artist, Bertini, of Milan, a noble work, as a specimen of the skill of the artist; but this very work, fine as it is technically, is a proof of the correctness of our views. An attempt is made in this to embody certain of the incidents of a work of imagination (the divine comedy of Danté); with what result, we would ask? The effects are intended to be strictly pictorial,—taking, of course, nature for their model; but from the character of the material upon which the picture is produced, while the forms and manner of treating are in accordance with fine art, the effects, from the transparency and brilliancy of the colored glass, are those of a gorgeous decoration. This very excess of brilliancy and transparency, which form the chief defect of colored glass, with reference to fine art, are the cause of its pre-eminent suitableness to its earliest and most appropriate use. During the latter part of the sixteenth and the whole of the seventeenth centuries, the art of staining glass became more and more neglected; and, although it cannot be said to have, at any period, passed entirely out of use, its employment, compared with preceding ages, was reduced to the lowest degree. In the early part of the eighteenth century a few struggling rays began once more to be emitted from that which had become nearly extinguished; and, in England, the art, or rather an art, of glass painting, began gradually to develope itself. To say that this was a revival of the ancient monumental glass painting, would be incorrect: we believe that the paintings executed at this period were all, more or less, enamellings upon colorless glass; and the style of the subjects, and the manner of treatment, prove that the object of the artist was to produce, as nearly as possible, those pictorial effects upon glass, which, in point of fact, can only be attempted successfully in the fresco or upon the canvass. There can be no doubt, that to produce enamels is much more difficult, and requires a higher degree of artistic skill than the old glass painters possessed; the process of enamelling is itself a difficult art; and unfortunately, when employed upon glass, it comes, after all, in great measure, to waste of labor. We do not mean to argue, that by modern processes very beautiful works have not been produced; every one must admit such to have been the case; but, at the same time, we believe that the spirit in which stained glass has been employed, generally, by modern painters, is a mistaken one; and that it is altogether false in principle, and abortive in practice, to attempt to fix upon stained glass anything beyond the function of decoration.

When we come to examine closely into the means which the ancients had at their disposal in the production of their stained windows, it will be at once perceived that, although limited in extent, they were fully sufficient to the production of any variety of effect in color. We have already mentioned the colors in glass which they could manufacture; and these, it will be found, comprise the means of producing the most striking combinations. The early glass-workers were also acquainted with the process of flashing glass, as it is technically termed; at least, they employed that process in making their ruby glass: this flashing consisted in giving a thin coating of color to a body of common colorless glass. With the ruby glass the process of flashing was always followed, as the depth of that colored glass was so great, that if it had been itself made thick enough to have the necessary strength, it would have had the appearance of black glass; it therefore became requisite to make the ruby very thin; and, to obtain at the same time the strength necessary in its employment, it was made in union with white glass, as we have already mentioned. Some of the old writers, on the subject of glass painting, having found that the ancient ruby glass was colored only on one side, conceived that this color was produced by a kind of enamelling; and some go even so far as to say, that they could perceive the traces of the brush used in laying on the fusible coloring material. At a later period, other colors, besides the ruby, came to be produced upon the same principle; and modern glass-makers have shewn, that every tint of glass may, if necessary, be manufactured by surface coloration.

The application of the color, in thin coats, gives to the glass painter certain advantages, which indeed, to some extent, was made available by the old painters. If it be desired to produce, for instance, any ornamentation upon the surface of a piece of glass, colored as above, the color can be easily removed by grinding the surface to a sufficient depth to cut through it: this, of course, can be done according to any pattern; and the parts so denuded of color can either be left colorless or afterwards colored, according to the common process of enamelling. A good illustration of this operation may be seen in some kinds of glass vases, in which two or more colors are introduced. The colorless body of the glass is here sometimes endowed with two superficial colored layers, and the effects are afterwards obtained by cutting through these in different degrees. Plenty of specimens of this glass may be seen at the Exhibition in the foreign department in the nave, and among the English glass in the north gallery.

With respect to the coloring principle of the ancient ruby glass, many fallacious notions have been entertained. The secret of its manufacture was certainly for a long period lost; it was generally thought to have been colored with oxide of gold,—but this is now known to be incorrect. That the oxide of gold will produce a fine ruby tint in glass, is well known; and this color possesses the peculiarity of withstanding, without undergoing any change, a very intense heat: indeed, although this auriferous glass is sometimes nearly or quite colorless when it first comes from the glass furnace, it only requires to be heated before the glass-modeller's blow-pipe to cause it to become of the most beautiful crimson. The ancient ruby glass was not, however, colored with gold, but with a mixture of the suboxide of copper and peroxide of iron. We have already stated that the process of manufacturing this ruby glass is no longer a secret, as an inspection of the works in stained glass at the Exhibition will, indeed, sufficiently prove. In connection with the manufacture of ruby glass, we are reminded of an anecdote :—It is said that during the first French revolution, some individual, following the popular idea that the ancient ruby glass was colored by means of gold, proposed to the National Convention to melt up all the remains of this glass, in the painted windows of the churches, for the purpose of extracting the gold. The Convention, catching at the idea, and, doubtless, expectant of opening up a mine of treasure, confided to the hands of a chemist a portion of the precious glass; upon examination, however, he discovered no gold, but a little of the oxides

of copper and iron. Is it not possible that this e
so abortive with reference to its immediate object,
been the means of indirectly restoring to the a
staining the secret of producing a material most e
its advancement?

In examining the stained glass at the Exhibiti
peared to our judgment, that, setting aside a fe
in pictorial style, the English artists have much to
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doubtedly bear away the palm from their contine
petitors. Owing to the omission of numbers from t
we find ourselves in the same difficulty we menti
former paper, namely, that we cannot refer to
specimens; and we have already mentioned the
some of the principle exhibitors. Being placed, a
nearly all in one portion of the building, these
afford a most favorable opportunity of comparing th
styles, both of the ancient glass of different periods
other, and of the ancient with the modern. We t
among other useful objects promoted by the Exhibi
painting may receive some impulse; and that the be
which aided, in great measure, in giving the peculia
and impressive character to the ancient churches, an
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servile copyists of the patterns and designs left us
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in which it is placed, and the proscription of its appli
pictorial art. We believe that there is a general str
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out, there can be no reason why the artist should not
his inventive powers in the production of new desig
combinations of color; as it is the spirit and not the
the ancient masters in this art, which we hold up to im

TEXTILE MANUFACTURES.

The great interest which has of late been excit
public mind with respect to the raw material flax-
by the enlarged sphere of application which is sup
be opened out to it by the discoveries of M. Claus

more particularly from the fact, that it is a material of home growth, and capable of production in unlimited quantities in Ireland—would seem to demand from us special comment. We are not the less inclined to this course, as the public is ever ready to take upon trust the practicableness of any new projects, when their promised results chime in with any feeling of sympathy that happens to pervade the community: thus, where the interest of Ireland is concerned, we find that commercial schemes for aiding its advancement are eagerly seized upon, and confided in almost without enquiry; but this is far from a prudent course. There can be no question that the flax trade is the growing manufacture of Ireland, and, as such, too much attention cannot be given to the production of the raw material; it has therefore been encouraged in every legitimate way; but it may be questioned whether the late announcements which have been made of its almost universal applicability to textile fabrics, will not tend to direct capital to too great an extent into this now thriving branch of industry, and thereby quickly induce a false and ruinous competition between manufacturers.

Flax, although apparently, from its fibrous character, better suited by nature than either cotton or wool to be formed into thread, nevertheless presents many difficulties to manufacturers which are quite foreign to the working of these short staples, and which can only be in part remedied by the adoption of a somewhat different process of manufacture. In contradistinction to cotton, which may be considered the fruit of the plant, flax is the filamentous substance contained in the stalk of the plant. It has therefore to be obtained by stripping off the bark or woody coating, termed the "boon." But, in order to effect this, as well as to detach the fibres from each other, it is necessary to dissolve the gum or resinous sap, which pervades the plant, and binds the several parts together. Various plans have been suggested for attaining this end; and it is upon the efficiency of the process adopted that the ultimate success of the flax trade mainly depends. When it is understood that the growth of the flax plant is principally in the hands of small farmers without capital, and that the bulk of the flax when reaped is so disproportionate to the yield for manufacturing purposes as to preclude the removal of the article to any great distance in the state of straw, it will readily be seen, that no process of dissolving the gum, or of "retting," as it is termed—requiring the purchase of expensive apparatus, or demanding the exercise of scientific knowledge—can be brought into general use, however efficient that process may prove to be. It cannot, therefore, be wondered at, that the old plans of water-retting and dew-retting still prevail, although a far superior method, which we shall presently explain, has been introduced.

Retting is simply bringing the plant to a certain stage of decay, which causes a perfect loosening or separation of its fibres. In carrying out the water-retting process pits are dug in the ground and filled with water, and the flax is thrown in in bundles, and pressed down by weighted boards, to keep it under water. After a short time fermentation commences, and in about ten days (more or less, according to the mean temperature) the decaying process will have proceeded sufficiently far; the flax is then taken out and dried, and the boon is removed by hand. The retting may be carried on in either running or stagnant water; but the latter, although the more expeditious method, requires closer watching, to prevent the flax from losing its strength of fibre by over decay. It will be obvious, that the exposure of large masses of vegetable matter to putrefaction must generate such exhalations as are very injurious to the health of the community; yet this practice not only prevails, but will, as we think, necessarily increase in proportion to the increase in the growth of the plant, unless some energetic means are adopted to put down the practice. Dew-retting is a process that is less objectionable, but its operation is far slower, and it is altogether beyond the means of many farmers to adopt. In this instance the flax is strewn thinly over meadow or grass land, and there submitted to the action of the air, dews, and rain, which, in a period varying (according to the mean temperature) between three and six weeks, will effect the required disunion of the fibres of the plant. This plan has an advantage over the water-retting, inasmuch as the flax is yielded of a brighter color,—the latter process being very apt to impart a deep stain to the fibres, as well as to destroy their tenacity.

The improved plan of retting, above alluded to, was introduced into Ireland from the United States in 1847, by Mr. Schenck, of New York. It had been tried there successfully upon hemp; the strength of the fibre, when made into cables, having been proved in some of the government navy yards to exceed any that had been retted on the old system. The process was patented in the United Kingdom in 1846, and is now in profitable work near Belfast. A recent inspection of the factory will enable us to state in detail the manner of proceeding to separate the long fine fibres of the flax from the boon. The principal apartment in the building contains a number of large circular vats in which the flax is steeped, and these are provided with steam-pipes connected to the steam-engine boiler. The flax to be operated upon is placed in these vats and piled up to a given height; strong cross-bars of wood, forming a kind of framework, are then laid above the flax and secured to the respective vats,—the object of this framing being to keep the flax down in the vat, as otherwise it would rise as it swelled in fermenting, and protrude above the water. When a mass of flax is thus secured, water is run into the vat, and as it becomes absorbed more water is added. Steam is now admitted into and made to circulate through the steam-pipe at the bottom of the vat, so as to raise the water to about 90° Fahr., and maintain it at that temperature. In a few hours acetous fermentation is established in the vat, and the decomposition of the resinous or gummy matter in the stalk proceeds with rapidity. After about sixty hours the decomposition is completed, and that without the exudation of any inodorous or noxious effluvium. The water surcharged with the mucilage is then drawn off, the framing is removed, and the flax is taken out of the vat to be dried, either in the open air or by artificial means. Thus, not only is the objection to the old plan, on the score of injury to health, removed, but a considerable economy in point of time is effected; the flax also is less liable to deterioration, in color and strength of fibre, if ordinary care is used in conducting the operation. When the weather is favorable for drying in the open air, the flax, tied up in tufts or handfuls, is suspended in rows, tier above tier, in an open framing, covered in at top by a penthouse roof. This mode of packing admits of a large quantity of flax being stowed in a small compass, and yet allows of a free access of air through the whole mass. When it has hung a sufficient time to dry, it is next submitted to the scutching operation. Or, instead of open air drying, the flax, in damp weather, is piled loosely in a drying chamber, into which a current of air, heated after Messrs. Davison and Symington's method, is passed, and the moisture is quickly expelled. The cost of this operation, as carried on at the works, must be very trifling, as the waste steam from the engine, which works on the high pressure principle, is found amply sufficient for heating the air: an advantage consequent on this mode of heating is, that no carelessness on the part of the attendants will render the air liable to be heated to an extent that would injure the flax. The flax, having been retted and dried, is next carried to the rolling or crushing mill, and there passed, by hand, between rotating horizontal rollers, which crack the boon already loosened by the retting process, and spread, or partially separate, the long fibres. The flax, as it is delivered out of the machine, is gathered up by boys, and handed to others, who submit it by handfuls to the action of rotating knives. These knives are attached to the face of a vertical wheel, several of which are mounted on one and the same shaft, at about three feet apart, and receive motion from the engine. There is an attendant stationed at every wheel, whose duty it is to submit the flax to the action of the knives, by holding it over a fixed bar, contiguous thereto, and allowing the rotating knives to strike the flax in the direction of its length. When the boon on one half-length of the flax is broken away or knocked off, the flax is turned over, and the other end is subjected to similar treatment. To further clear the flax of the woody particles, it is again submitted to a similar operation before another set of wheels,—the action of the knives being, in this instance, more thorough and searching, as the flax has now approached nearer to a stick of fine fibres. Having undergone this treatment, the flax is now ready for sale in the market; and it is in this state that it enters the flax-mill, to be acted upon by the heckling-machine, for the removal of the tow or short staple, prior to undergoing the various operations of preparing and spinning, to convert it into yarn. From this description, it will be understood, that, so long as the cultivation of flax is in the hands of small farmers, Mr. Schenck's process is not likely to put the old practice out of use; for the water-retting is carried on at little or no outlay of money; and the cleaning of the flax by hand is made a sort of wet-day occupation: the bulk of the flax in the state of dry straw—which, as we have before said, is so disproportionate to the amount of useful fibre as virtually to prevent its carriage to any distant part prior to undergoing the retting operation—scarcely exceeds, when carried to the market, 20 per cent. of its original weight.

M. Claussen's patented process (the merits of which have been so confidently paraded) does not seem to be in favor with the Irish flax spinners, although the specimens contained in the Exhibition appear to the eye to realize everything that could be wished; but here, as in many other manufactures, it is not the attainment of a high degree of excellence that is the difficulty, but the cost at which such a result may be arrived at. Thus flax may be dressed from the straw—as, indeed, it was once proposed to be done—without being subjected to the retting process. The waste of material, however, soon shewed the impracticability of the plan, although a good article was produced; it is possible, therefore, that M. Claussen's specimens may have been obtained without regard to cost. We do not assert this as a fact, but rather to shew that, in commercial matters, no just conclusions can be arrived at without the question of cost being taken into account. His mode of treating the flax will be readily understood from the following description, which we have compiled from his specification:—The straw, having been stripped of its seeds, is steeped in a solution of caustic alkali, of about the strength of 1° Twaddle's hydrometer, either in a boiling state, which renders an immersion of six hours sufficient, or at a temperature of 150° Fahr., which will necessitate the continuance of the immersion for about twelve hours. By this means, the glutinous matters, which connect the fibres with the woody portions of the plant, are dissolved, and the coloring matters contained in the straw are discharged and prevented from staining the fibres. When the flax is required to be spun in long staple, the straw is next steeped for about two hours in dilute sulphuric acid, containing one part of acid to from two to five hundred parts of water, for the purpose of ridding it of the alkali which it has taken up; the straw is then removed from the acid-bath and well washed in water: this is one process. But the one which has raised the public curiosity, is that which purports to split the fibres into fine filaments, like those of cotton or wool. This operation is effected as follows:—The straw is put into a bath containing a strong solution of bicarbonate of soda, and allowed to remain there for three or four hours. When well saturated with the bicarbonate, it is immersed in water, acidulated with sulphuric acid, in the proportion of one part of acid to two hundred parts of water; the sulphuric acid will then combine with the soda and effect the disengagement of carbonic acid gas in the fibrous tubes, which gas, by its expansive force, will split the fibres into fine filaments, having the appearance of fine cotton wool, and capable of similar treatment. This splitting process may be applied to the plant either in the state of straw, or after it has been retted and brought to the state of long fibre; and it is therefore capable of general application, as far as the inconvenience arising from bulk is concerned. What manufacturers will eventually say to working up fibres that have been steeped in sulphuric acid, may depend upon the means taken to extract this corroding substance from the flax; but at present we think there is a strong feeling against its use.

Another process for treating flax is shortly to be introduced, which is said to surpass that of M. Claussen's in its results. This is the patented invention of Mr. Bower, of Hunslet; but as his specification is not yet enrolled, we withhold, for obvious reasons, the details of his plan, and forbear to express any opinion of its practicability. The treatment of flax, in its early stages, is a matter of vast importance to this country; and perhaps there is no one problem throughout our manufactures whose solution would better repay the successful experimenter, than how the facilities for working cotton and wool are to be communicated to flax?

LABOR-SAVING MACHINES.

The British portion of the Exhibition contains numerous examples of the application of machinery to economise labor in the processes of washing, wringing, and mangling. The washing-machines may be divided into three classes, viz., first, those which have a rotary action; secondly, those wherein vibrating beaters are employed; and thirdly, those in which vertical beaters are alternately raised and permitted to fall upon the clothes.

In the first class, Mr. V. Price, of Wardour-street, Soho, has a simple machine, consisting of a cylinder or drum, to contain the clothes, revolving horizontally in a close wooden vessel, or outer case, which holds the soap-suds. The drum is made with solid ends; but (in order that the soap-suds may have free access to the clothes) the periphery or body thereof is composed of wooden bars or spokes, extending from one end to the other, with a space, somewhat greater than the width of a bar, between the adjacent bars, so as to resemble what is known to engineers as a "lantern drum." The clothes are introduced by opening a door in the side of the drum; and on rotary motion being given to the drum by a handle, the soap-suds will be caused to act upon and thoroughly cleanse the clothes.

Mr. J. Adams, of Selby, exhibits a machine, in which the articles to be washed are placed in a perforated wooden barrel or octagonal vessel, rotating horizontally in an outer case. Above the case two wooden rollers are mounted, one over the other; and the clothes, when sufficiently washed, are passed between such rollers, so as to squeeze out the soap-suds, instead of wringing the clothes by hand. These rollers may be subsequently used for mangling the clothes.

Another rotary machine, exhibited by Mr. Pearson, of Leeds, consists of a tub or wooden vessel, in which the clothes are thrown; and the requisite agitation for washing or discharging the dirt is effected by means of an upright beater, which rotates in the tub in the same manner as the "dasher" of an upright rotary churn. This apparatus is also provided with a pair of rollers for wringing and mangling the clothes.

The next machines of the rotary class, which we shall notice, are those of Messrs. Manlove, Alliott, and Seyrig, of Lenton Works, Nottingham. In these machines the operations of washing and drying are effected by centrifugal force: that is, on the mop-trundling principle. The utility of this construction of machines, both for washing and drying fabrics, is unquestionable; and, under slight modification, they are extensively used for the refining of sugar. Each machine may be described as consisting simply of a drum, having its periphery formed of wires, and being fixed to a vertical shaft, which rotates in the centre of a cylindrical metal case. The goods to be washed are put into the drum, and water is supplied thereto through a hollow central shaft. On rapidly rotating the drum, the water is caused, by centrifugal force, to pass outwards through the goods, and through the wire periphery of the drum, into the outer case, from which it is conducted away. To dry washed or wet goods, they are placed in the drum without access of water, and by the rapid rotation of the same the moisture in the clothes is discharged,—the time required for drying in no case exceeding five minutes. These machines are suitable for washing and rinsing dyed goods; but they are not applicable to the washing of thoroughly dirty clothes: they may, however, be used for rinsing the same after they have been washed by other means.

Mr. Robinson exhibits a machine for drying wet clothes, which acts upon the same principle as the above. The drum that receives the wet clothes is formed of round iron bars, with spaces between them, and mounted on a horizontal shaft. By means of a row of bars the drum is divided into two compartments, which receive the goods through a door formed in the drum-ends; and the whole is enclosed in a circular iron case, which is open below. The goods having been put into the drum, it is caused to revolve with great rapidity, and the moisture is expressed from the goods by centrifugal force, and escapes through the opening in the bottom of the case.

Another rotary washing machine is exhibited by Mr. Nunn. It consists of a large drum, which is mounted upon a horizontal shaft, within a close vessel or case, and carries numerous small rollers all round its periphery,—such rollers being capable of turning freely and independently of each other, and their axes being parallel to the axis of the drum. The case contains water or soap-suds, in which the drum is immersed to the extent of about one-fifth or one-sixth of its diameter; the clothes are kept in contact with the drum, as it revolves, by several endless tapes; and as the clothes successively arrive at the upper part of the drum, they are acted upon by five fluted rollers above it.

Mr. Nunn contributes another machine, which appears to be designed for rinsing aud wringing only. Two fluted rollers, one above the other, are mounted in the upper part of a wooden vessel or trough; an endless band passes over the lower roller, for the purpose of conducting the clothes between the fluted rollers; and there is another endless band below, immersed in the water which the vessel contains, and passing over a roller at each end of the vessel,—its apparent use being to receive the clothes as they fall from the first band, and bring them again to that end of the vessel where they were introduced.

Machines of the second class, viz.,—those wherein vibrating beaters are employed, are exhibited by Messrs. Fryer, Tasker, Marsden, and Reid. In Mr. Fryer's machines, an upright board or beater, having vertical slots or openings in it, is caused to vibrate or swing to and fro in a segmental vessel (containing the clothes to be washed, and a suitable quantity of soap-suds), and beat the clothes against the side of the vessel until they are thoroughly cleansed.

In Mr. Tasker's machine, a beater, with vertical slots or openings in it, vibrates in a trough or vessel having a series of projecting ribs at each side, corresponding with the openings in the beater.

The beater, in Mr. Marsden's machine, has a projecting rib affixed to it, on each side, between the several slots or openings; and at each side of the segmental trough or vessel, in which the beater works, there is hinged a flap or false side, with numerous horizontal slots or openings in it.

The three last-mentioned machines are all provided with rollers for wringing and mangling the clothes.

Mr. Reid's machine consists of a large square box, the bottom of which takes the form of the segment described by a vibrating beater suspended in the box. The machine also contains a ".wringer," which is a net formed into a bag, having an opening at the side for the introduction of the wet clothes; and at each end of the bag there is a screw-bolt, with a nut upon it, by one of which the bag is to be secured to the side of the machine, and by the other it is connected to a crank, which, on being actuated, will twist the bag, and thereby express the water from the clothes. At the back of the machine several rollers are mounted one above the other, for the purpose of mangling the articles.

Mr. W. Macalpine, of Hammersmith, exhibits a machine of the third class, constructed with ascending and descending beaters. It consists of a cylindrical metal vessel, which is fixed upon an upright axis, and is caused to rotate by means of suitable wheel-work in connection with a steam-engine. The vessel is made with perforated false bottom and sides, so as to form a hollow casing, into which steam may be admitted, and may thence pass through the perforations, and act upon the water and the fabrics to be washed. The process of agitating or washing the fabrics is effected by nine or ten upright beaters, arranged in a row across the interior of the vessel, and alternately elevated and permitted to fall upon the fabrics.

Messrs. Wilkinson, Stutterd, Baker, Moreton, and others, exhibit machines for performing the operation of mangling only; but as these, whatever their respective merits, cannot be said to be new applications of machinery for economizing labor, they do not properly come within our province.

From the above notice it will be seen that considerable attention has been given by machine-makers to that most important branch of domestic economy—washing. There is not, perhaps, one of the machines, above described, which would not as effectually cleanse all under-clothing as the most fastidious could desire; and yet we still suffer our clothes to be tortured by the rubbing and wringing of those merciless modern Amazons who preside over soap-suds, and allow them to be transformed into lint and ribbons, without an attempt at removing the annoyance: indeed, so inveterate is prejudice, that the washerwoman may yet look for a long lease of her profession, as it luckily touches upon no established manufacture.

While on the subject of washing, we may direct attention to a machine, exhibited by Mr. C. Farrow, of Great Tower-street, for washing bottles. In this machine, a horizontal metal spindle, carrying a bottle-brush at each end, is caused to revolve by being connected with a treadle. A bottle is pushed over each brush by the operator, who holds the bottles, one in each hand, whilst by means of his foot he works the treadle and causes the rotation of the brushes.

Specimens of those very useful machines which have lately been introduced for cleaning knives and forks are to be found in the building, and demand some notice. Mr. Kent's machine consists of a box or case, containing a couple of wooden discs, fixed near to each other upon a horizontal iron rod or spindle, which passes through the case, and is caused to rotate by means of a winch-handle. Each disc is, for about three-fourths of the area of its inner face, covered with alternate rows of bristles and strips of leather; and the remaining fourth part is covered with bristles only. The knife-blades to be cleaned are introduced through openings in the case, between the rubbing surfaces of the discs; and rotary motion being given to the discs by a winch-handle, the knives are rapidly cleaned and polished.

The machines exhibited by Mr. Masters are constructed upon the same plan as the above; but the rubbing surface of each disc is formed of strips of buff leather, with only a narrow circle of bristles around the edge of such surface to clean the shoulders of the knives: small brushes are fixed beneath the holes in the case through which the blades of the knives are inserted, to prevent the exit of dust from the apparatus.

Mr. Price exhibits a machine for cleaning knives, and another for cleaning forks. The knife-cleaner consists of a horizontal drum, covered with pieces of leather or felt, and fixed within another drum or circular framing, lined with leather or felt. The knives are introduced through openings in a moveable circular plate at the front of the outer casing, and enter between the surfaces of the two drums. The plate is fixed upon a horizontal axis, which extends through the case, and is furnished at the back with a handle; by turning which the disc is caused to rotate and carry round the knives between the surfaces of the drums. The fork-cleaner consists of a box, with a long rectangular opening in the side; behind which two brushes are fixed, face to face. Between these brushes the prongs of the forks are introduced, and the handles are secured in a carrier, which is made to advance and recede alternately by means of a throw-crank, and thereby thrust the prongs into and draw them out of contact with the brushes. The carrier consists of two metal plates, the lower one carrying a cushion of vulcanized India-rubber for the fork-handles to rest upon, and the upper being lined with leather; they are hinged together at one end, and are connected at the other, when the handles have been placed between them, by a thumb-screw.

The same exhibitor also contributes a chopping-knife for the reduction of suet, &c., into small particles. It consists of three blades, fixed side by side to the lower surface of a flat metal frame, which is hinged at one end to a fixed metal pillar or support, and at the other is provided with a handle, whereby the blades are alternately lifted and brought down upon the suet or other substance to be chopped, which is laid upon a circular wooden dish or chopping block. Each time that the knife-frame is raised, a hooked rod, suspended therefrom, catches into the teeth of a ratchet-wheel, and turns it partly round; on the axis of this ratchet-wheel is a small cog-wheel, which takes into the teeth of a circular rack or wheel, fixed to the underside of the chopping-block; and thus, at each ascent of the knife-frame, the block will be moved partly round, and made to present fresh portions of suet to the action of the descending knives.

RECENT PATENTS.

To William Edward Newton, *of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, civil engineer, for improvements in machinery or apparatus for producing ice, and for general refrigeratory purposes,—being a communication.*—[Sealed 22nd August, 1850.]

This invention is based upon the well known physical law that air, in expanding, will absorb heat from substances which may be brought into contact with it; and it consists in a means of applying this property of air to general refrigeratory purposes, and particularly to the conversion of water into ice.

In carrying out the object of this invention, atmospheric air is compressed, in order that it may be in a condition to expand to its former bulk: this operation is accompanied by the disengagement of heat, which it is expedient to absorb and carry off. The compressed air is then allowed to expand, in intimate contact with the substance to be cooled; and, while expanding, it absorbs the heat of such substance. The absorption of the heat, disengaged by the air during its compression, is effected by bringing in contact with it a jet of water or other suitable fluid. As the substances which are to be cooled do not part instantly with their heat, it is expedient to allow the air to expand gradually, in order that sufficient time may be afforded for the substance to part with its heat, and for the air to absorb it.

To avoid the inconvenience that would arise from mingling the substance to be cooled with the expanding air, an intervening agent is employed, which is alternately brought into contact with the vessels containing the substance to be cooled and the expanding air, and therefore acts as a vehicle to take the heat from the substance to be cooled, and to give it out to the expanding air. The intervening agent most suitable for this purpose is a liquid which is uncongealable at the temperature to which the article to be cooled is to be reduced.

In order to compress air a considerable amount of force must be expended; but, as the air in expanding from a compressed state will exert considerable force, the refrigerating apparatus is so arranged that the force which the compressed air exerts in expanding shall aid in reducing another quantity of air to the requisite degree of compression: hence, the force expended in compressing air is, to a considerable extent, recovered by its subsequent expansion.

To prevent the introduction into the apparatus of impurities with which the atmosphere in many localities is charged, and also to facilitate the attainment of a very low temperature, it has been found advisable to use the same air again and again. These several points, which are deemed essential to the efficient and economic working of refrigerating apparatus, acting by mechanical in contradistinction to chemical means, will be found to be embraced in the arrangement of apparatus forming the subject of the present invention.

This improved construction of refrigerating apparatus consists essentially of an engine, by means of which air is compressed or condensed,—of receivers or reservoirs, into which the compressed air is forced,—of an engine, in which the compressed air from the reservoir expands and exerts its force to aid in working the condensing engine,—of suitable pumps to inject jets of water into the condensing engine, to absorb the heat disengaged by the air as it is compressed,—of similar pumps to inject the uncongealable liquid into the expanding engine, in order that its heat may be absorbed by the expanding air,—and of a refrigerating chamber or room, in which the articles to be cooled are placed, and which also forms a reservoir for the uncongealable liquid,—the latter being drawn from it to be forced into the expanding engine, whence it is returned to the room, after it has given out its heat to the expanding air.

In Plate II., fig. 1, is a plan view of one of the forms of apparatus devised for carrying this invention into effect; fig. 2, is a side elevation of the condensing engine; fig. 3, is a similar elevation of the cylinder and valve-gear of the expanding engine; fig. 4, is an end elevation of the two engines, and of the reservoir of compressed air; and figs. 5, to 11, represent various detached portions of the machine in plan, section, and elevation.

The condensing engine consists of a cylinder A, which is secured to a strong bed-frame B, and is fitted with a piston C. The piston is secured to a piston-rod D, which passes through a stuffing-box *a*, in the cylinder head *b*, and is fitted at its outer end with a cross-head E. This cross-head is linked by a connecting-rod F, with the pin G, of a crank H, secured to one extremity of a driving-shaft I, to which a rotary motion is imparted by the prime mover, through the intervention of cog-wheels J, J¹, or some other suitable device, and which is also furnished with a fly-wheel K, to equalize its motion. The extremities of the cross-head are fitted with guide-brasses *c*, which run upon a pair of stationary guides *d*, *d*, secured to the bed B. The cylinder is furnished at each extremity with a valve-chest L, L: these are alike in every particular, and each contains two valves, with their appropriate valve-seats. One of the valves (*e*,—see fig. 7,) in each chest opens upwards and inwards, to admit air into the cylinder, when the piston is moved by the revolution of the crank from that end of the cylinder. The other valve *f*, opens outwards, to allow the air compressed by the piston, when moving towards that end of the cylinder, to pass into a pipe *g*, *g*, through which it flows to an independent receiver M, M; and from the latter it passes through a pipe *h*, *h*, to a larger or main receiver N, which receives the air passing from the two smaller ones.

The pump, by means of which the water of injection is supplied to the air, while being compressed in the cylinder A, is of the variety termed double-acting. It consists of a barrel O, which is bolted fast to the cylinder, and is furnished at each extremity with a valve-chest P, P, containing an entry-valve *j*, and an exit-valve *k*, (see fig. 9.) It is also fitted with a solid piston, which is secured to the inner extremity of a piston-rod R; and the latter passes through a packing-box *l*, in the head *m*, of the pump-barrel, and is secured to a cross-head S, which is guided by a pair of guides *n*, *n*, fig. 1, and is connected by a rod T, with an arm U. This arm is keyed to one extremity of a shaft V, which is supported in blocks on standards V^2, secured upon the bed B;—to the other end of the shaft V, a pendent arm W, is keyed; and this arm is connected by a rod X, with the prolonged extremity *i*, of the crank-pin G;—the whole arrangement being such, that, as the crank H, revolves, the piston is caused to move to and fro in the pump-barrel. One or both of the arms U, W, are perforated with a series of pin-holes; so that the pins, to which the extremities of the connecting-rods are applied, can be shifted towards or from the centre of the shaft V, to vary the stroke of the pump. That portion of the valve-chest of each pump, in which the entry-valve is situated, is connected by a pipe Y, with the well or other source whence the water of injection is to be drawn; and that portion of each valve-chest, in which the exit-valve is situated, is connected by a pipe Z, with the head of the condensing cylinder adjoining it, so that the water issuing from the pump-barrel will pass into the condensing cylinder. The pipe Z, which conveys this water to the cylinder, is forked, and each of its forked extremities terminates in a perforated piece or rose-head *q*, (fig. 4,) by means of which the water is diffused, in a shower of fine spray, throughout the interior of the condensing cylinder.

The expanding engine is similar in its construction to the condensing engine, with the exception that it is lined with brass, and that its valves are moved by valve-gear, put in motion by the revolution of the driving-shaft. The cylinder A^1, of this engine is mounted upon a bed-frame B^1, and is fitted with a suitable piston C^1; the piston-rod D^1, passes through a stuffing-box A^1, and is fixed to the cross-head E^1; this cross-head works in guides d^1, d^1, and is attached to the connecting-rod F^1, which is linked to a crank-pin G^1, on the wheel H^1; and the latter is secured to the opposite extremity of the same driving-shaft I, to which the crank H, of the condensing engine is secured. The enlarged portion of the rim of the wheel H^1, is perforated with a series of holes, all equidistant from its centre, in order that the crank-pin G^1, may be shifted from one hole to another, to force the piston of the expanding engine to commence its stroke when the piston of the condensing engine has completed such desired portion of its stroke as may be found expedient to equalize the motion of the driving-shaft. The cylinder A^1, is also furnished at each extremity with an entry-valve e^1, and an exit-valve f^1, (figs. 6, and 8.) These are situated in valve-chests L^1, L^1, which are secured to the opposite ends of the cylinder. The valves are each fitted to the lower extremity of a stem, which passes up through a stuffing-box in the bonnet above; and each is also guided, in rising and falling, by a stem, which extends through a cross-bar below it. The stem *s*, of each entry-valve is connected with an arm *t*, (figs. 3, and 8,) of a rocking-shaft *u*; the latter is supported in suitable blocks upon the bed-frame B^1, and is fitted with a depending arm *v*, which is connected by rods *w*, *x*, with a lever *y*, to which a vibratory motion is imparted by a cam A*, on the driving-shaft. The cam acts upon a friction-wheel *z*, which is pivotted to the vibrating lever *y*: it is of such form that it shall cause each entry-valve to open as the piston leaves that extremity of the cylinder at which the valve is situated, and shall allow each valve to close at that point of the stroke at which it is desired to cut off the entrance of the compressed air. The stem s^1, of each exit-valve is actuated by valve-gear, similar to that described for working the entry-valve e^1,—namely, the arm t^1, the rocking-shaft u^1, the depending arm v^1, and the rods w^1, x^1, which connect the depending arm v^1, of the rocking-shaft with its appropriate vibrating lever y^1. The cam A**, which puts these vibrating levers in motion, is of such form that each exit-valve is opened as the piston begins to move towards that end of the cylinder at which it is situated, and is allowed to close as the piston arrives at the end of its stroke: these valves are therefore open, to allow the escape of the expanded air and uncongealable liquid, throughout the whole stroke of the piston.

The pump, by means of which the uncongealable liquid is supplied to the expanding air, is, in this instance, secured to the side of the cylinder A^1. It is similar, in its construction and operation, to the pump of the condensing cylinder;—O^1, being its barrel; P^1, P^1, its valve-chests; S^1, the cross-head (the guides of which are shewn at n^1, n^1,); T^1, the connecting-rod of the pump; V^1, the rocking-shaft; V^3, the standards, to support the shaft; and U^1, W^1, the arms, to which the rods T^1, X^1, are pivotted. This pump draws the uncongealable liquid through a suitable pipe Y^1, from the refrigerating room, and forces it into the expanding cylinder through pipes Z^1, which terminate in rose-heads *q*, *q*, (fig. 4,) similar to those used in the condensing engine. The compressed air is conducted from the main reservoir N, to the valve-chests L^1, of the expanding engine, by a pipe B*; and the expanded air and cooled uncongealable liquid, which escape from the expanding engine, are conducted by suitable pipes C*, C*, (fig. 1,) to the refrigerating room.

The refrigerating room is represented in horizontal section at fig. 10, and in sectional elevation at fig. 11. It consists of a close chamber, which is placed at a convenient distance from the expanding engine. Its interior is divided by suitable partitions *a*, *a*^{1}, into a large chamber D*, and into a series of smaller ones E*, and E**. One of the partitions (*a*^{1},) which separate the smaller chambers from each other, is solid from top to bottom; and the others (*a*,) are perforated, to allow the uncongealable liquid to circulate round the larger chamber. The pipes C*, C*, through which the uncongealable liquid and expanded air are conducted from the expanding engine, terminate in a single-forked pipe F*, which introduces the air and liquid at one end of the series of small chambers. The last chamber E**, in the series is connected with the valve-chests L, L, of the condensing engine by a pipe G*, through which the expanded air, after passing through the whole series of chambers, is conducted to the condensing engine, to be recompressed into the air-reservoir N. This last chamber is also connected, at the lower part, by the suction-pipe Y^1, with the pump O^1, which supplies the uncongealable liquid to the expanding engine. Each chamber is fitted with a moveable cover *b*, which should be made of some substance that is a bad conductor of heat; and the walls *c*, and bottom *f*, of the refrigerating room are made double, in order that a stratum of some bad conductor of heat (charcoal dust, for example) may be inserted in the hollow space, to prevent the conduction of heat to the interior.

The machine, thus described, is intended particularly for the congelation of water; and the series of small chambers E*, E**, are constructed to admit and support vessels H*, in which the water to be frozen is introduced. These water vessels are formed of thin sheet metal, which will rapidly transmit the heat of the water within them to the cold uncongealable liquid by which they are surrounded; and the sides of these vessels converge downwards, to permit the block of ice formed in them to be removed with greater facility.

If the vessels H*, were filled with the water to be frozen before the process of congelation was commenced, and the water was suffered to remain quiescent, a casing of ice would form on the sides of each vessel at an early stage of the operation, and thereby retard the passage of heat from the unfrozen water within to the uncongealable liquid without: the conversion of the mass of water into ice would thus be rendered a very slow operation.

Various methods of obviating this difficulty have been essayed; but four only of these plans are deemed worthy of special mention. The first consists in jarring or rocking each water vessel by the action of suitable machinery connected with the apparatus. The second consists in agitating the water by means of a stirrer, kept turning in it by power until the mass of water is at the point of congelation, when this instrument is suddenly withdrawn, and the water allowed to solidify. A third method consists in scraping the interior surfaces of the freezing vessels by scrapers, which are moved incessantly against them, so as to detach the films or scales of ice from the sides of the vessel as fast as they are formed thereon; by which means fresh portions of water are brought in rapid succession in contact with the sides of the vessel; and, when the great part of the water has thus been converted into thin pellicles of ice, the scrapers are withdrawn, and a solid lump of ice is almost immediately formed: these scrapers should have acute edges, and be actuated by the driving machinery. The action of the stirrer or scraper may be suspended by the action of the machinery itself, after the water has been subjected to the refrigerating effects of such a number of strokes of the expanding engine as experience may dictate; or the action of these instruments may be suspended by means of a thermostat (or other analogous device that will put in motion the mechanism), by which the stirrer is withdrawn, whenever the temperature of the water sinks to a determined point. The fourth and last of these methods consists in supplying the water to the freezing vessels gradually, and only as fast as it will freeze. In order to effect this, a water-pipe I*, is conducted around the refrigerating room, and is fitted at intervals, corresponding with the positions of the chambers, with branch pipes *g*, which enter holes made in the covers of the chambers, and are fitted in such manner that they can be turned up (as represented in dotted lines at fig. 11,) to be out of the way when the covers are to be opened. Each branch pipe is fitted with a cock *h*, by means of which the supply of water can be regulated; and each is also fitted with a disc *h*¹, which closes the opening in the cover. The large central chamber D*, in the refrigerating room, may be used for preserving or cooling substances, or for storing the products of the apparatus. The various pipes which convey the uncongealable liquid and the expanded air to and fro, should be coated with some bad conductor of heat, to prevent them from absorbing heat from the surrounding atmosphere; and it is also advisable to insulate the expanding cylinder and its jet-pump in the same manner.

In manufacturing ice with this apparatus, the power of the prime mover is applied to turn the driving-shaft I, which, by means of the cranks H, H¹, communicates an alternating movement to the pistons C, C¹, of the condensing and expanding cylinders A, A¹, respectively, and puts in operation the other moving parts of the apparatus. When the piston C, moves from either end of the cylinder, the exit-valve *f*, thereat is closed; while the corresponding entry-valve *e*, is opened, by the air rushing in to fill the partial vacuum caused by this movement of the piston; and, as the piston approaches the opposite end of the cylinder, the air before it is condensed, the entry-valve *e*, is closed, and the exit-valve *f*, is opened by the pressure, to allow the condensed air to pass into the pipes *g*, by which it is conveyed to the receiver M. Upon the return stroke of the piston these operations are reversed, and the air drawn in during the preceding stroke is compressed into the reservoir. While the air is being compressed in the cylinder of the engine, heat is disengaged, which is absorbed by the injection water, forced into it in fine jets through the rose-heads by the pump O; and, as the piston alternately arrives near each end of its stroke, this water of injection is forced out with the compressed air through the exit-valve into the pipes *g*, *g*, which conduct the same to the intermediate receivers M, M. In these receivers the air and water separate;—the air passes out through the pipes *h*, *h*, (fig. 2,) to the main reservoir N; while the water lodges in the bottoms of the intermediate receivers, whence it escapes through pipes provided for the purpose. The orifice of each of these escape-pipes is provided with a valve, which is connected with a float in its respective receiver; so that, as soon as the water rises above a certain predetermined height, the valve is opened by the float, to permit its escape. Two intermediate receivers are provided, each of which receives the air and water from one side only of the piston of the condensing engine; and these receivers are furnished with thermometers, an inspection of which is sufficient to indicate whether the condensing engine is performing its work in a proper manner. The compressed air in the main reservoir is conducted by the pipe B*, to the expanding engine; and, as the driving-shaft revolves, the entry-valve at that end of the cylinder from which the piston is moving, is opened by the valve gear, to admit the compressed air. As soon as the piston has completed a predetermined portion of its stroke, the valve gear closes the entry-valve;—the air in the cylinder, being thus separated from that in the reservoir, expands as the piston continues moving towards the opposite end of the cylinder; and, at the same time, the pump O^1, at the side of the cylinder, injects the uncongealable liquid, in a shower of fine drops or spray, into the expanding air, which absorbs its heat, and thus cools it. As the piston returns in the cylinder, the exit-valve is opened, and the expanded air and cooled liquid are expelled by the piston and conducted to the refrigerating room. They enter the refrigerating room at one end of the series of chambers E*, and pass in succession through the whole series to the last chamber E**, from which the air escapes by the pipe G*, provided for the purpose; while the uncongealable liquid is drawn off by the pump O^1, to be re-injected into the expanding engine; and, as the latter is double-acting, each stroke of the piston will expel a fresh quantity of the expanded air and cooled liquid, which, in their passage through the series of chambers, absorb the heat of the articles placed therein. As the piston of the expanding engine is connected with a crank H^1, on the driving-shaft I, the force exerted by the expanding air will tend to turn the driving-shaft, and will thus aid in driving the condensing engine: by which means a large amount of the power expended in the condensation of the air is recovered; while, at the same time, as the movement of the piston is gradual, the compressed air is compelled to expand gradually, and a sufficient space of time is given to allow the heat of the uncongealable liquid to be absorbed. As the air, on escaping from the refrigerating room, is still at a very low temperature, it may be used to cool the water to be frozen, by passing it through a vessel in which a worm pipe is fixed, through which this water passes on its way to the refrigerating room. The temperature of the expanded air, after leaving this worm vessel, is still below that of the atmosphere; it has therefore been deemed expedient to conduct it to the valve-chests of the condensing engine, to be re-condensed into the air-reservoir; and, as the pipe which conveys this expanded air to the condensing engine is liable to obstruction from the precipitation of moisture therein, it should be provided, at its lowest point, with a self-acting float-valve, whereby the moisture can be discharged whenever it rises above a determined limit,—which, in all cases, should be below the level of the entry-valves.

In order to facilitate the repair of the apparatus when any one portion of it becomes accidentally deranged, suitable valves should be inserted in the various pipes which convey the air and uncongealable liquid to and fro, in order that any portion of the apparatus may be thrown out of gear, and opened for repair, without disturbing the other portions, or allowing the compressed air in the reservoir to escape. There should be suitable pressure-gauges on the receivers, to shew the tension of the air within them, and thermometers, to indicate the temperature of the same. Adjustable cut-off valves should be provided, to regulate the admission of the condensed air into the expanding engine: any adjustable cut-off apparatus in use on steam-engines will answer for this purpose,—the only object to be attained by adjustment, being the power of proportioning the quantities of air expanded to those compressed, in such manner that the tension of the air in the reservoir shall remain constant.

From the above description it will be understood, that the action of the machine is continuous,—fresh portions of air being compressed and cooled, while fresh portions of the compressed air are expanded, to absorb heat from the uncongealable liquid; and fresh portions also of the uncongealable liquid (which have absorbed the heat of the articles placed in the refrigerating room) being drawn off by the pump and injected into the expanding air, are then returned, in a cooled state, to absorb fresh portions of heat in the refrigerating room: the uncongealable liquid acts therefore as a vehicle to take the heat from the articles to be cooled, and to give it out to the expanding air. It is also evident, that as the water injected into the condensing engine and the uncongealable liquid in the expanding engine are denser than air, they will be forced out last; and hence, when either piston arrives at the end of its stroke, the space between it and the valves will be filled with a substance which, being almost incompressible, will not re-expand when the piston returns, and prevent the entrance of air: the quantity of air therefore discharged at each stroke (if no leakage takes place) will be equal to the area of the piston multiplied by its stroke.

The uncongealable liquid, which has been employed with success in freezing water with this apparatus, is an alcoholic spirit; but there are many other liquids which do not congeal at the temperature at which it is desired to cool many substances, and may therefore be employed in certain cases with advantage.

This method of refrigeration has been described with special reference to the manufacture of ice; but, with slight and obvious variations in the minor details, it is applicable to other purposes; as, for example,—to the cooling of the atmosphere of buildings, and of steam and other vessels; the maintenance of a low temperature in buildings, in which particular branches of manufacture are carried on that can be prosecuted, to the best advantage, under a regular and low temperature; the cooling, with greater rapidity, large masses of hot liquid which ordinarily cool slowly (as, for example, the worts in breweries); &c. Whenever it is deemed advisable to cool gaseous fluids, by mixing them with the expanding air, they may be injected, by means of the force-pump, into the cylinder.

The patentee does not confine himself rigidly to the details of the apparatus, as above described; as many variations can be made, both in the form and arrangement of the parts, without deviating from the principles of the invention: thus, for example, the engines, instead of being of the horizontal variety, may be built upon the general plan of any engine in use for working steam at the same tension as that of the compressed air; the construction of the intermediate receivers and reservoir may also be varied; and the latter, instead of consisting of a single cylindrical vessel, may be composed of a series of smaller vessels, connected together by suitable pipes.

The water of injection, after its temperature has been raised by cooling the condensed air, may be employed to feed the boiler of the steam-engine which propels the machinery; and in this way effect a saving of the fuel which would be required to raise it from the temperature of the ordinary source of supply to that at which it is thus furnished. The force with which the water issues from the receivers, under the pressure of the condensed air, may, if it is deemed expedient, be used to aid in propelling the machinery, or to actuate supplementray machinery.

The arrangement of the refrigerating room may be modified, as expediency may require, to suit the circumstances of any particular case: thus, in some instances, it may be advisable to mount the water vessels upon wheels, and to introduce them at one end of the series of refrigerating chambers, and cause them, in succession, to pass towards that end of the series at which the cooled liquid enters.

The patentee claims, First,—the means for effecting the absorption of heat disengaged from air during its compression in the condensing engine. Second,—the use of an engine, so arranged as to render the expansion of the compressed air gradual, in order to obtain more fully its frigorific effects, and at the same time to render available the force which the air, in expanding, exerts, to aid in working the condensing engine. Third,—the use of intermediate receivers, to which the compressed air and water are conducted, in order that they may separate before the air passes into the main reservoir. Fourth,—the construction and use of the refrigerating room or chamber, connected by pipes with the chambers or cylinders in which the condensation and expansion of the air is effected. And, Fifth,—the means whereby he is enabled to utilize the expanded air and subject it to re-condensation, for the purpose above described.—[*Inrolled February,* 1851.]

To James Henry Baddeley, *of Shelton, in the county of Stafford, engineer and designer, for improvements in the manufacture of ornamental articles of earthenware.*—[Sealed 17th October, 1850.]

The principal object of this invention is to manufacture from plastic materials cornices, ornamental bricks, and other like architectural decorations, so as to obtain, in an economic manner, sharp and clear impressions of the designs required to be reproduced.

A plastic material is first prepared in the following way:—Clay or cream marl, which will assume a white or cream color when burnt, is soaked in water in a cistern for twelve or fourteen hours,—during which time it is occasionally agitated, so as to separate the clay, until it becomes reduced to a sort of pulp. When the clay is in this state, certain matters, hereafter mentioned, are added thereto, which will give a vitreous character to the clay when burned, and yet allow of the firing being expeditiously effected; and then it is run from this cistern and passed through a fine sieve, to clear it from dregs or extraneous matter: this clearing operation ensures a good white color, and prevents the appearance of spots in the articles when burnt. The washed marl or pulp is next run into an evaporating tank, formed of brickwork, and heated by a flue passing underneath it. While under the action of the heat, the pulp is occasionally stirred, to prevent the clay from burning at the bottom; and the evaporation is continued until the clay becomes stiff enough to undergo the operation of beating or kneading: this beating or kneading process is for the purpose of rendering all parts of the clay equally plastic, or bringing it to a right temper for moulding. In order to give a vitreous character to the moulded articles, and produce a surface that will be impervious to or but slightly absorbent of the color used for embellishing them, there is added to the clay, when in a state of pulp, some vitrifiable substance, such as felspar or Lynn sand, in the proportions of a hundred-weight of Lynn sand, or a hundred-weight of felspar, to a ton of clay. The vitrifiable substance, previously to being mixed with the clay, is ground to powder, and to it about twenty pounds (more or less) of common salt or soda are added, which will assist in fusing the vitreous substance, and thereby effect a great economy in the firing operation. The bat of clay or plastic material, after undergoing the kneading process, and being then of the consistency of stiff dough, is brought to the preparation press, shewn in Plate II., and submitted to great pressure, in order to drive out the air therefrom, and bring the material to a proper state for being moulded.

Fig. 12, is a front elevation of the preparation press, and fig. 13, is a cross section, taken in the line 1, 2, of fig. 1. It consists of a cylinder *a*, mounted between standards *b*, which are bolted to a bed-plate *c*, and carry at their upper part a cross-piece *d*. In this cross-piece is mounted a hollow shaft *e*, which has a female-screw formed on its interior, to receive a screw *f*. To the upper end of the shaft *e*, is keyed a bevil-wheel *g*, and into this wheel gears a pinion *h*, mounted on a horizontal shaft *i*, which turns in bearings in a bracket-piece *k*, attached to one of the standards *b*. The screw *f*, is provided, at its lower end, with a piston *l*, which fits the cylinder *a*, and is driven down upon the plastic material contained therein, in order to compress it and force it out at the vent *m*. Over the vent is placed a dod or die *n*, which may be of any required shape, according to the sectional form which it is intended the plastic material shall assume when forced out of the press. *o*, is an inclined trough, to receive the exuding material, which proceeds from the press in one continuous sheet, and is then to be cut into any desired lengths. The piston is raised and lowered by giving rotation to the shaft *i*, which, through the pinion *h*, will cause the wheel *g*, and its shaft *e*, to revolve, and thereby effect the rise and fall of the screw which carries the piston.

By submitting the plastic material to the action of this press, not only is the consolidation of the material effected, but it is also brought to the embryo shape of the design which it is intended to assume; and thus the operator is enabled to produce good casts or impressions of designs, in high relief, by means of mechanical pressure in metal moulds. For instance, if it is desired to make a brick, with an ornamental boss in high relief on the face thereof,—instead of using a dod with parallel or straight edges, to bring the plastic material to the required breadth and thickness for insertion into the ornamental mould, the patentee so forms the upper working edge of the dod that it will produce a greater sectional thickness, in the material issuing from the press, at about the middle of its width; so that when the sheet of material is cut across, into pieces that may be called embryo bricks, each piece will have a ridge or raised portion on its face, the sectional area of which must be equal, or nearly so, to the cavities of the sunken parts of the mould. By thus having an apparent surplusage of plastic material, he is enabled to ensure the proper filling in of the cavities in the pattern-mould, and that with the application of a comparatively small amount of pressure,—the pressure being in great part applied to the spreading of the ridge or ridges brought in contact with the mould-face, and not to the disturbance of the general mass. Another advantage which the improved construction of dod gives is, that being made in two pieces, as shewn at fig. 12, the sectional thickness of the sheet formed by the press may be varied, without changing the dod, by merely shifting the position of one of the pieces of which the dod is composed.

The plastic material, when pressed into a sectional shape, approaching the sectional form of the pattern it is designed to receive, and cut up into suitable lengths, is ready to be submitted to the fly-press, shewn in front elevation at fig. 14, and in sectional elevation at fig. 15. This press is, in construction, very similiar to the ordinary fly-press. On the bed *a*, of the press, a pair of parallel rails is fixed, and upon these a plate *b*, slides. This plate is provided with four concentric lugs, as shewn at fig. 16, which represents the mould affixed to the plate *b*, and thrown open ready to receive a bat of clay. *c*, is a table, which carries the mould, and is furnished, on its under side, with a circular rim or flange, which rests upon the plate *b*, and is firmly attached thereto by set-screws, passed through the lugs of the plate. By this means the position of the mould, which is attached to the table *c*, is capable of a nice adjustment, so as to bring it directly under the plunger *d*, of the press. *e*, is a stop-pin, for determining the distance that the plate *b*, is to be run in to bring the mould under the plunger. The pattern, for producing the ornament upon the article, is preferred to be made of brass; it is shewn at *f*, (which represents a pattern for an ornamental brick); and it is fixed to the table *c*, by screws, which enter the back of the pattern. Upon or around the edge of the pattern is placed a frame *g*, which forms the sides of the mould; and jointed to brackets standing up from the table *c*, is the top frame *h*, of the mould: which frame is provided with an opening, of the exact dimensions of the face of the plunger *d*, to allow of the descent of the plunger on to the plastic material. This frame *h*, after the frame *g*, has been set in its place, and the plastic material has been laid on the pattern, is fastened down by means of a latch, with which it is furnished, taking into a catch on the table *c*. When the mould is thus made ready for the descent of the plunger, rotary motion is given, by the hand, to the fly-wheel, whereby the plunger *d*, is caused to descend and compress the plastic material, so that it will completely fill the cavities in the pattern *f*. A reverse motion is then given to the fly-wheel, and the plunger is withdrawn from the mould. The plate *b*, (together with the table *c*, and the mould) is now drawn from under the press, the latch is unfastened, the top frame thrown back, and the loose frame *g*, which brings with it the embossed brick, is lifted off the pattern *f*. The frame *g*, is next turned over, so as to bring the embossed or ornamented surface of the brick upwards; and it is then discharged, with its plain side downwards, on to a board or tray. In repeating this operation, the pattern face is brushed over with "trotters' oil," to prevent the adhesion of the plastic material to the mould; the frame *g*, is next placed over the pattern; a bat of plastic material, prepared as before, is then laid in the mould; the frame *h*, is brought down and fastened; and the charged mould is pushed forward under the plunger, which is caused to descend as before mentioned, and complete the formation of another brick. In this instance, the surplus plastic material is allowed to escape between the frames *g*, and *h*; but to prevent the necessity for clearing the four sides of the mould, after the discharge of each brick or other article formed therein, the patentee has found it desirable to allow the escape of the surplus plastic material at one side only of the mould. For this purpose, he constructs the mould as shewn in plan view at fig. 17, and in cross section at figs. 18, which is taken in the line 1, 2, of fig. 17. The metal pattern *f*, which, in this instance, contains four repeats of the drop of a cornice, is attached temporarily to the table *c*, by pins, projecting from the table and entering the back of the pattern; and partly round three sides of the pattern a V-groove is formed, into which a corresponding V-projection on the face of the plunger *d*, fits. The bat of plastic materials, having been first brought to the embryo shape of the article required to be produced, in the manner before explained, is laid on the pattern *f*, (the irregular or ribbed surface of the bat being in contact with the pattern-plate *f*,) and the plunger is brought down and made to press upon the bat. Any surplus clay which the mould may contain will then be forced out at the front of the mould, which is left open for that purpose. V-grooves are formed across the pattern-plate *f*, between each repeat, for the purpose of cutting apart or separating the repeats from each other. When the pressure of the plunger is removed, the table carrying the mould is drawn forward, and a plaster of Paris bat is laid over the plastic material; the mould being then lifted off the table and turned over, the cornice-drops and waste-pieces discharge themselves from the pattern on to the plaster bat; and the moulded drops are removed on the bat to the drying-house. When dry, the articles, manufactured according to this invention, may be packed in saggers and fired in the usual way.

In conclusion, the patentee says, it will be obvious, from the above description, that he is enabled to make a great variety of articles of decoration in relief; he does not therefore confine the application of his process to the manufacture of ornamental bricks and cornices, as above pointed out; but he claims its application and use for the manufacture of all such articles of earthenware, having ornamental designs in relief, as are capable of being discharged from the pattern-plate or mould in a finished state, in the manner above described.—[*Inrolled April*, 1851.]

To JOHN LIENAU, jun., *of Wharf-road, City-road, in the county of Middlesex, merchant, for improvements in purifying or filtering oils and other liquids.*—[Sealed 18th January, 1851.]

THE specification of this invention is very carelessly prepared, and the drawing accompanying it is exceedingly inaccurate. We give the description *verbatim;* but the drawing (fig 19, Plate II.,) we present in a somewhat amended state, in order to render it more intelligible.

The patentee commences his description as follows:—"In order to form a superior oil for lubricating and burning purposes, I have invented the following process:—I take such a quantity of the following essential oils, or any of them, *videlicet*, oil of cummin, oil of aniseed, creosote, oil of rosemary, and pour the same into the raw oil, either mineral, animal, or vegetable, as will produce fermentation. After this has been done, the oil is passed through the filtering apparatus in the following manner:—The bag G, is fastened in the interior of the vat A, by means of the iron hoop J, and rests at the bottom on the perforated cover B,—the latter resting on the iron frame C. The oil or liquid is then poured into the bag, and the pumps D, are set in motion. Whilst these, creating a vacuum, draw out the oil or liquid from the bottom of the vat, the oil or liquid passes through the nozzles of the pumps, and is ready for use.

Description of the Apparatus.

A, wooden or metallic vat. B, wooden or metallic perforated cover. C, iron frame, on which the cover B, rests. D, air-tight suction pumps. E, iron supporters. F, iron handle. G, bag,—woollen, cotton, or linen. H, valves, through which the air and refined liquid pass. J, iron hoop."—[*Inrolled July*, 1851.]

To EWALD RIEPE, *of Finsbury-square, in the City of London, merchant, for certain improvements in refining steel,—being a communication.*—[Sealed 5th December, 1850.]

THIS invention consists in refining raw or crude steel (particularly puddled steel), by placing bars or lumps thereof in a furnace or other heating chamber, where the atmospheric air cannot exert an injurious action upon it, and subjecting it therein, for a suitable time, to a temperature not exceeding that which will melt steel.

The patentee states, that he uses a welding furnace, such as is ordinarily employed in puddling iron, only that the bed is lowered, the grate is brought from two to four feet below the level of the fire-bridge, and the ash-pit is furnished with an iron door, by which it can be completely closed. When the furnace is in full heat, the bars or lumps of raw or crude steel are laid on the bed of the furnace, and arranged so that they may not touch each other at any part. During the whole of the refining process, the fire-place is kept fully charged with coal or other fuel; any crevices in the working-door, or elsewhere, are carefully luted with wet clay, in order to prevent, as much as possible, the access of oxygen; and the draft of the furnace is so regulated, by means of the ash-pit door and flue-damper, that the heat shall never reach the melting point of steel. A sufficient practical test of the heat is furnished by the color of the flame, which is watched through an eye-hole in the working-door: as long as the flame remains of a dull or hardly red color, the heat will not be greater than is requisite. From nine hundred to one thousand pounds of raw or crude steel, in bars of three inches by an inch and a half, are usually placed in a furnace of the ordinary size; and the operation is continued for about four hours. In this process, carburetted hydrogen and oxide of carbon are produced in the furnace in abundance, while the oxygen of the air is effectually prevented from acting on the steel; and the product is steel of a very fine uniform grain.

The patentee does not restrict himself to the use of any particular form of furnace, nor to the subjection of the raw or crude steel to the refining process in any particular quantities, or of any particular sizes. He claims the refining of raw or crude steel (particularly puddled steel) by placing it in a furnace or other heating chamber, out of the reach of any injurious action upon it by the atmospheric air, and there subjecting it for a time to a temperature not exceeding the melting point of the steel.—[*Inrolled June,* 1851.]

To Alexander Mein, *of Glasgow, accountant, for certain improvements in treating the fleeces of sheep when on the animals,—being a communication.*—[Sealed 7th December, 1850.]

The subject of this patent is an invention of the late James Smith, of Deanston, for treating the fleeces of sheep, when on the animals, by the employment of two chemical solutions, prepared suitably for obtaining, when used in succession, an insoluble, or nearly insoluble, and water-repellent coating to the fibres of the wool,—in place of using the grease and matters commonly employed: by which means, the natural clothing of sheep will be rendered waterproof, and not only will the health of sheep be benefitted, but the wool, after its removal, will be found more valuable for manufacturing purposes.

The materials used in carrying out this invention are those well known to chemists, and which have before been employed for rendering woven fabrics repellent of moisture, by first impregnating them with one solution and then with the other, so as to leave the fibres of the fabrics coated with an insoluble or moisture-repellent matter. The chemical solutions preferred are, a solution of alum, and a solution of soft soap, commonly called black soap. The solution of alum is composed of about twenty pounds of alum to forty gallons of water: the alum is first dissolved in four gallons of hot water, and then thirty-six gallons of cold water are added; and this quantity will be sufficient for dipping one hundred sheep. The solution of soap is prepared by dissolving about thirty pounds of soap in a like quantity of water. The sheep are dipped in a trough, about four feet long and two feet and a half wide, and containing about twenty gallons of the solution of alum. The dipping is most conveniently performed by three men,—two to hold the legs, and the other to hold the head up out of the solution when the body is immersed. The sheep is to be held with its legs upwards, and the body dipped and moved about in the solution; the men who hold the legs must use one hand to rub the solution in amongst the fleece; and care should be taken to cause the solution to enter thoroughly amongst the fibres. The operation of dipping a sheep will take about half a minute; it is then to be lifted out, and placed upon a board by the side of the trough, so arranged that the solution which drains off may run back into the trough; and the men are to press the liquid as much as possible out of the wool. After this, the sheep is to be allowed to stand till its coat is nearly dry (which will be in about two hours); and then it is to be dipped in the solution of soap, in the same manner as it was dipped in the alum solution. Immediately the last dipping is completed, the sheep may go to its pasture; and if the dipping has been carefully performed, each fibre of the fleece will possess the quality of repelling water; and thus the wool will be kept dry, the warmth of the animal secured, and the fleece improved for manufacturing purposes.

Instead of the solution of soap, a solution of glue or other gelatinous matter may be employed. The well known substances, such as arsenic and preparation of sulphur, used for preventing the attacks of insects on sheep, may be employed in combination with the above mode of making wool repellent, and may be applied either mixed with the solution or separately, as they have hitherto been used.

The patentee does not confine himself to the above details; but he claims the application of chemical solutions, suitably prepared to obtain, when used in succession, an insoluble or sparingly soluble water-repellent coating to the fibres of wool when on the animal.—[*Inrolled June*, 1851.]

To WILLIAM REES, *of Pembrey, in the county of Carmarthen, coal agent, for certain improvements in the preparation of fuel.*—[Sealed 18th January, 1851.]

THIS invention consists in converting small coal, or a mixture of coal and coke, into solid blocks of fuel without the aid of extraneous cohesive matter.

In carrying out this invention, the patentee takes small bituminous coal, or bituminous coal mixed with coal of other qualities or with coke, and puts the same into a cast-iron mould, composed of four fixed and two moveable sides;—the latter being made to fit as nearly air-tight as is practicable; and one of them being slightly larger than the other, as hereafter mentioned. The mould, after being filled, is kept for a period, varying from thirty minutes to three hours, in a stove or chamber, heated to from 500° to 900° Fahr.: the time and temperature vary according to the quality of the fuel operated upon;—coals containing least gaseous matters requiring a higher temperature, while those containing more volatile matters require a lower and more gradual heat to bring them to the desired consistency or cohesive state without the disengagement of gas. The coal or mixture, while undergoing this operation, expands until it becomes to some extent pressed by the sides of the mould, and those parts thereof which would, if freely exposed, be converted into gas, become fused and the whole mass brought to a soft or pulpy state: the mass will retain its cohesion when cool, will have the same form as the interior of the mould, will be of nearly the same specific gravity as it was before being operated upon, and, when broken, the fracture will resemble that of large coal. When the coal or mixture has been brought to the desired consistency, the moulds are removed from the stove or chamber, and allowed to cool. The larger of the two moveable sides of the mould is then removed, and the other being pressed down, the block of fuel is delivered from the mould fit for use.

In order to obtain blocks of fuel of greater density (which is very desirable for the use of steam vessels) any machine for compressing fuel, while in a state of fusion or partial fusion, may be employed to force the smaller moveable side into the mould, and thus compress the block of fuel into a smaller space. The coal should be dried before it is introduced into the mould, to prevent the generation of steam; but it should not be subjected to a heat sufficient for the production of gas: the drying may be effected on the top of the stove or chamber, so as to save the expense of fuel for that purpose. To economize labor, the moulds are preferred to be placed upon low carriages, which are mounted upon small wheels, and enter the stove at one end, and (after remaining therein a suitable time) leave it at the other end. The stove should be made sufficiently large to contain several carriages. The number of moulds upon each carriage, and the dimensions of the moulds, may be varied. A convenient size for the moulds is stated to be 10 × 6 × 4 inches. If the fuel is to be compressed, the mould should be made one-half higher, so that the fuel may be compressed to two-thirds of its original bulk. The sides of the mould should incline outwards from the top to the bottom, to the extent of one-sixteenth of an inch, to facilitate the delivery of the block of fuel.

Instead of using moulds, a pipe, of suitable area in the transverse section, may extend through the stove or chamber, in such manner that the centre part thereof may be heated by the stove, while its ends remain cold. The coal or mixture is introduced at the upper end of the pipe; each portion sufficient for forming a block of fuel is divided from the next by a circular iron plate, corresponding in diameter with the interior diameter of the pipe; and the different portions, when brought to the desired state of fusion or consistency, are discharged from the lower end of the pipe by the action of a piston.

The patentee does not confine himself to the above details, so long as the peculiar character of his invention is retained. He is aware that the heating of small coal, in order to soften it preparatory to its being compressed into moulds or made into blocks, has been proposed. He therefore does not claim this as part of his invention; but what he claims is, the confining coal or admixture of coals and coke in moulds or vessels that are air-tight, or nearly so, and exposing the same to heat and pressure in the manner above described,—thus retaining the gaseous constituents of the coal under pressure, and causing them to aid in the fusion and ultimate cohesion of the mass into a compact fuel.—[*Inrolled July*, 1851.]

Scientific Adjudication.

COURT OF COMMON PLEAS.

(Sittings at Nisi Prius, before Mr. Justice Williams and a Special Jury.)

June 20th and 21st, 1851.

HANCOCK *v.* SOMERVELL AND ANOTHER.

Sir F. Thesiger, Q. C., Mr. Serjeant Channell, Mr. Webster, Mr. Grove, and Mr. Karslake, conducted the plaintiff's case; and the Attorney-General, Mr. Serjeant Byles, and Mr. Hindmarsh, were counsel for the defendants.

This action was brought for the infringement of a patent, granted to the plaintiff, November 21st, 1843, for "improvements in the preparation or manufacture of caoutchouc, in combination with other substances, which preparation or manufacture is suitable for rendering leather, cloth, and other fabrics waterproof, and to various other purposes for which caoutchouc is employed."

Sir F. Thesiger, in opening the plaintiff's case, stated that the plaintiff was a gentleman who had long been connected with the waterproofing and India-rubber trade. The defendants were wholesale dealers and importers of goloshes and various other waterproof articles, carrying on business in Noble-street, Cheapside. The plaintiff, who was associated in business with Messrs. Macintosh, the well-known firm at Manchester, had, in conjunction with them, taken out several patents for inventions connected with waterproofing and the manufacture of India-rubber goods; and for many years he had been aware of certain defects in this class of goods, but had failed to suggest a remedy. The principal defects were—first, a clamminess and sticky quality, generally observable in glutinous preparations; and, secondly, a peculiar liability to be affected by heat and cold, and also by grease or oil. To remedy these evils, and render the manufacture more extensively useful, the plaintiff had, for many years, been giving great attention to the subject. In 1842, Mr. Moulton, agent to Mr. Goodyear, of New York, came to England, and, having introduced himself to Messrs. Macintosh, wished to treat with them concerning the sale and manufacture of articles in this country, in which the before-mentioned objections had been obviated. Messrs. Macintosh were unwilling to enter into any negociations with Mr. Moulton, as he was not in possession of the secret of Mr. Goodyear's manufactures, and could not state whether their expensive plant and fixtures could be made available if they undertook to make articles under Mr. Goodyear's process. After several interviews, therefore, all negociations were broken off. Mr. Moulton, however, left some specimens of Goodyear's inventions with Messrs. Macintosh, intimating that it was impossible for them to discover the secret, and that Mr. Goodyear was not at all apprehensive on that score. Mr. Goodyear did not take out a patent in this country; and Mr. Hancock then (probably assisted by some hint he might have obtained from an examination of the specimens left with him by Mr. Moulton) commenced a series of experiments, which ended in the discovery that, by mixing the silicate of magnesia with the caoutchouc, he could entirely obviate the clamminess and adhesiveness of the latter material. Prior to these experiments the combination of sulphur and India-rubber had been tried; but the combination of these two alone did not prevent the temperature having an effect on the material. Mr. Hancock continued his experiments, and ultimately discovered that by melting sulphur in an iron vessel at 250° Fahr., and then immersing therein sheets of caoutchouc prepared with the magnesia, and keeping them immersed until the whole attained a temperature of from 270° to 285°, he could obtain every object he aimed at in his preparation. Having ascertained this satisfactorily, Mr. Hancock obtained a patent for his discovery, as above stated; and in his specification he made the following claims:—"What I claim as my invention and discovery is, first,—the combination of caoutchouc with silicate of magnesia, whereby manufactured caoutchouc is rendered free from that clammy and adhesive character which it usually possesses; secondly,—I claim the modes herein described, of combining asphalte with caoutchouc; and, thirdly,—I claim the treating of caoutchouc (either alone or in combination with silicate of magnesia or other substances) with sulphur when acted on by heat, and thus changing the character of caoutchouc, as herein described." This preparation of Mr. Hancock's, which was well known as vulcanized India-rubber, entirely superseded the use of ordinary India-rubber for all manufacturing purposes, and the manufacture became a very profitable business. Shortly after it came into general use, parties imported articles to a very large extent from America, all of which were manufactured from a similar substance to that patented by the plaintiff; and Messrs. Macintosh, considering that the importation of such goods amounted to an infringement of Mr. Hancock's patent, issued advertisements, cautioning the trade against selling such goods. Shortly after this, they heard that the defendants had made a very large importation of goloshes, over-shoes, and other articles, made of the material in question; and on the 5th of October, 1848, a letter was written to them in Noble-street, giving them notice that if they persisted in selling such articles, proceedings would be taken against them. No notice having been taken of this letter, the plaintiff's solicitor sent a person to their warehouse, who purchased from them articles to the amount of £1. 3*s.* 6*d.* These articles were analyzed, under Mr. Hancock's direction; and the result proved that the effect which rendered the caoutchouc insensible to the variations of temperature, &c., was due to sulphur. There was a quantity of oxide of lead mixed with it; but this, it was alleged, had nothing to do with producing the effect.

In support of the plaintiff's case, Mark Davis was called as a witness, who stated that, in October, 1848, he went to the defendants' warehouse, and bought three pairs of goloshes, and has had them in his possession ever since. He afterwards attended a meeting at the plaintiff's solicitors, at which were present Messrs. Graham, Aikin, Cooper, and Brande;—some pieces were cut off the shoes and delivered to Mr. Graham.

Mr. Cooper, the chemist, on being called, gave evidence that before the year 1843, when the plaintiff obtained his patent, he was well acquainted with the nature of caoutchouc and its applications to the arts; that prior to that date India-rubber or caoutchouc did not possess the property of resisting cold: a low atmospheric temperature rendered clothes made of caoutchouc stiff and rigid; and this was a great objection, as it was necessary to warm a garment before it could be put on. The witness then went on to state that he had assisted Mr. Hancock in his experiments, before the inrolment of his specification; and that since that date he had carried on the processes therein described, and found the results to be such as were set forth by the patentee. He had also analyzed pieces cut off from the shoes produced by the last witness, and found that they contained sulphur, caoutchouc, oxide of lead, and a trace of lime, and some other unimportant ingredients. His opinion was, that the shoes sold by the defendants to the last witness were prepared by sulphur, in the manner detailed by the plaintiff in his specification. He did not consider the introduction of the lead or other materials, except the sulphur, to be of any consequence; as the "change" produced in the rubber was due to the presence of sulphur alone. Upon cross-examination, the witness stated that he could not tell, upon a simple inspection of either plaintiff's or defendants' articles, whether the change had been produced under the influence of heat, or by other means. When Mr. Hancock shewed him his specimens he could easily, by analysis, ascertain what ingredients had been used, but could not positively state whether heat had been employed. Mr. Hancock explained the process to witness, who, thereupon carried it out successfully.

Mr. Cooper's evidence was corroborated by Messrs. Graham, Aikin, and Brande, who all spoke as to the sufficiency of the specification.

Mr. Woodcock, the manager of Messrs. Macintosh and Co's. Works, at Manchester, gave evidence to the effect, that specimens of rubber, prepared by sulphur, were brought to Manchester by Mr. Moulton, who acted for Mr. Goodyear of New York; they were shewn to Mr. Hancock and other of the principals of the firm of Macintosh and Co., prior to the date of Mr. Hancock's patents, and negociations were entered into about the sale of the invention; but nothing further was done, although some correspondence took place. Upon cross-examining this witness it appeared, that some of the specimens were left by Mr. Moulton, who stated that he saw no objection to so doing, as he had been informed that it would be impossible to ascertain, from a simple inspection of the specimens, how the change had been effected. The witness admitted, however, that he saw at once that sulphur had been employed in the process, as it came off in his hands, and he could distinctly smell it. Subsequently to Mr. Moulton's visit to Manchester, witness had been instructed by the plaintiff to make experiments; and, under his directions, witness had succeeded in producing the same change in rubber, and endowing it with the same properties as the specimens left by Mr. Moulton were found to possess. It appeared also that witness had (subsequent to Mr. Hancock's patent) been sent to America by Macintosh and Co., to gain information about the India-rubber manufacture; and that, while in America, he purchased machinery for the purpose, and had it sent to England.

Mr. Lloyd, of Woolwich Dockyard, Mr. Gregory, C. E., Mr. C. May, Messrs. Cow, and others, spoke as to the value of the invention, and the various useful purposes to which the prepared or vulcanized rubber had been advantageously applied.

This closed the plaintiff's case.

The Attorney-General (Sir Alexander Cockburn), in opening the case for the defendants, said that it was quite clear that, owing to the manufacture of Mr. Goodyear, the plaintiff had been induced to prosecute enquiries, out of which his patent had resulted. With respect to this point of the case, he would be able to shew that, at the time the plaintiff had applied for his patent, he was not in possession of the invention, as described in his specification; but that, if Mr. Goodyear's and the plaintiff's manufactures were alike, it arose from the fact of Mr. Hancock having availed himself of means other than that of his own inventive power to possess himself of the invention in question; and that not only had he no moral right to the exclusive use of this invention, but that, prior to the date of the plaintiff's patent, goods manufactured by Mr. Goodyear had been openly sold in the market by Mr. Moulton, as the agent for Goodyear, and that the novelty of the invention was thereby destroyed; and that, consequently, the plaintiff's patent was invalid on that ground. And further, that if, as it was maintained by the plaintiff's witnesses, sulphur was a material ingredient in the curing of India-rubber, Mr. Hancock had no right to an exclusive claim for that, as it was one of many ingredients in the preparation of India-rubber used by Mr. Fanshawe, under a patent of prior date. In order to shew that Mr. Hancock was not in possession of the invention in question at the time of applying for his patent, the Attorney-General submitted to the Court a copy of the paper which had been required by the law officers of the Crown to be deposited by Mr. Hancock, embracing the heads of the invention for which he was applying for letters patent;—the document bearing the date of 3rd November, 1843. He also presented a copy of the paper deposited by Mr. Newton, on behalf of Mr. Goodyear, for a patent for his process, bearing date 18th January, 1844. Hancock, it appears, had opposed the grant of Newton's patent; but it was decided that they were dissimilar, and therefore patents were granted for both inventions. These deposit papers ran severally as follows:—

"*Heads of Mr. Hancock's invention for improvements in the manufacture of caoutchouc.*"

"I contemplate a mode of obviating the clammy adhesiveness of its surface, also of manufacturing into masses combinations of caoutchouc with coloring matters, and rolling the same into sheets." "By means of flatting-mills for floor-cloths, and for covering caoutchouc stoppers, and for being used as a substitute for leather and other purposes; also for diminishing the stiffness of caoutchouc and its combinations, occasioned by its exposure to low temperature, and protecting those manufactures from the effects of oil and grease." "These improvements are effected by mixing and working up with the caoutchouc, during the process of its manufacture, Venetian or French chalk, silicate of magnesia, pigment, sulphur, drying-oils, spermaceti, lime, and other absorbent earths."

"*Particulars of invention, in the name of W. E. Newton, under the title of improvements in the preparation of caoutchouc or India-rubber, and in manufacturing various fabrics of which caoutchouc forms the component part.*"

"The principal improvements in the preparation of caoutchouc or India-rubber consist in the combining therewith portions of sulphur and of white-lead, and in submitting the compound, thus formed, to the action of heat at a regulated temperature: by which combination and exposure to heat it will be so far altered in its qualities as not to become softened by the action of the solar ray or artificial heat, at a temperature below that to which it was submitted in its preparation."

The absence of any mention of the application of heat in Mr. Hancock's particulars was submitted to be the absence of the very essence of the invention which was now sought to be protected; for it was by heat alone that the manufactured India-rubber could be protected from being affected in any way by the change of temperature. It was clear therefore that the invention was not in possession of the plaintiff at the time of applying for his patent; nor even in January, two months after the grant of his patent, or he would have stopped Mr. Newton's application for a patent; whereas the law officer of the Crown had decided that the two inventions, as then submitted for his examination, were dissimilar.

The Attorney-General then called several scientific witnesses to prove that the shoes sold by the defendants, although they contained sulphur, which he did not deny, were much superior to the goods manufactured by the plaintiff; and that they possessed properties quite foreign to those possessed by the plaintiff's goods. These witnesses proved that the introduction of lead was a great improvement; as it improved the polish of the shoes and other articles, and destroyed the unpleasant smell of the sulphur.

Mr. Moulton was called, and proved that negociations had been entered into by himself (on Mr. Goodyear's behalf) and the plaintiff and his partners, with whom he left several specimens of Mr. Goodyear's manufacture.

Mr. Wrench, an importer of foreign goods, stated that prior to the date of the plaintiff's patent he received from the United States samples of different articles;—some of which were shewn and sold to the plaintiff. Other evidence, to the like effect, was given by other witnesses.

Mr. Warne, of the firm of Granville and Co., stated that samples of Mr. Goodyear's articles were left with him by Mr. Moulton prior to the plaintiff's patent; but that no arrangement was made as to the purchase of the invention.

Mr. Mann and Mr. Lupworth, clerks to the Attorney and Solicitor-General, were called to prove the deposit, with the Attorney-General, of a rough or outline description by Mr. Hancock, prior to the issue of his patent; and also that a description of Mr. Goodyear's process was deposited by Mr. W. E. Newton, prior to obtaining a patent for the invention on Mr. Goodyear's behalf.

Mr. W. E. Newton proved that, in October, 1843, before the date of Hancock's patent, he received instructions from the United States to apply for a patent, in his own name, on behalf of Mr. Goodyear, for his invention of curing India-rubber; that an application was made accordingly; and that the patent was opposed by or on behalf of Mr. Hancock, who called on the witness and asked him for whom he was acting, and that witness declined to answer the question. Mr. Hancock then said, if witness was acting for Mr. Goodyear he would not oppose him; but, as he still got no satisfactory reply, the opposition to witness's patent was persevered in; and that, notwithstanding this opposition, the patent was granted by the Attorney-General, after hearing of all parties.

Mr. Fanshawe was then called, and proved that he had a patent, prior to the plaintiff's patent, for improvements in making sheathing from India-rubber, mixed with hair, pitch, and other materials, including sulphur; and that the mixture was submitted to heat. Upon cross-examination, however, the witness admitted that he did not introduce the sulphur for the same purpose as that intended by either the plaintiff or Mr. Goodyear.

JUDGMENT.

Mr. Justice Williams.—Gentlemen of the Jury, this is an action in which the plaintiff, Mr. Hancock, seeks to recover from the defendants, Messrs. Somervell and Burr, damages for having infringed a patent granted to Mr. Hancock, upon the 21st of November, in the year 1843; and there is no doubt that such a patent as that described in the declaration was obtained. That is not a matter at all now in dispute. But the first question that is raised in answer to this action, and to which I shall proceed in the first instance to draw your attention, is, whether there has been any infringement of that patent?

Now, the facts you know are that the shoes in question, the sale of which is said to be an infringement of the patent, were not manufactured by the defendants, but were manufactured in America, and sent to England, and there sold by the defendants. And, on the part of the defendants, it is not disputed that if the shoes were manufactured in America, in violation of the plaintiff's patent, and were sent to England, and sold by the defendants here, that that would be an infringement—it is the same thing evidently as though the defendants had themselves manufactured them in England; and you may treat it exactly as if they had.

The question, therefore, will be whether this manufacture is an infringement of the patent? That you must judge of for yourselves. I confess I do not feel that the case presents any very great difficulty. It is true you have heard from the evidence of the witnesses on both sides that the substance of which the American shoes are made is a different substance from that of which the English shoes are made;—the American shoes containing a quantity of lead, as much as 31 out of 100, in that proportion; and the effect of that has been to make certainly a somewhat improved article, more susceptible of polish, more firm, and free from smell. This question of infringement is a question for your consideration. You must now assume, for the purposes of this question, that the plaintiff has established that the invention specified by him, and which you have heard described by the witnesses, is his invention of vulcanizing the India-rubber; assuming that to be his invention, you must say upon this part of the case whether you feel any difficulty in coming to a conclusion that the defendants could not have made the shoes without availing themselves of that invention of the plaintiff's, and, therefore, whether that is not an infringement of the patent. You must judge of that for yourselves. It seems to me, assuming that to be a clear fact in the case, that the substances are different; yet it is plain that it would be impossible to make the American shoes, supposing they were made in England, without having recourse to the invention of the plaintiff; and if that is so, then you will have to say whether you have any doubt upon this question—that it is an infringement of the patent.

Then, if you think that is so, the next question that arises is upon what is called the novelty issues in this case; and upon that part of the case the defendants do not deny that the plaintiff, Mr. Hancock, is to be considered the inventor, notwithstanding that Goodyear had previously made the same discovery;—the defendants do not deny that, provided the invention had not somehow or other been published or in use in this country before the date of the patent of the plaintiff; and what is said on the part of the defendants is this,—I am now putting aside Fanshawe; for I take it for granted you are clear Fanshawe's patent does not at all affect the question of the novelty of the invention. Assuming that to be so, the defence consists of this: the defendants say that not only Goodyear had discovered the invention first (about which probably you will entertain no doubt), but also that the invention had been substantially published and was in use, not in secret use, but in public use in England before the date of the patent; and if that is so, it would entitle the defendants no doubt to a verdict upon these novelty issues. Upon that part of the case the view that it seems to me that ought to be taken by you is this: you will first consider whether the material was before the public,—it is not necessary it should be used by the public,—if it is in public use, not in secret use. The learned counsel, Sir F. Thesiger, put that a little too narrowly. I think there have been cases subsequent to the cases he cited, which have somewhat narrowed the effect of those cases. The law now as to the use need not be by the public, it must be a use in public, contradistinguished from secret use. If you should be of opinion the material was so before the public, in public use, before the date of the patent, then the question would be this: it is said on behalf of the plaintiff—first of all denying that there is any evidence of the material having been at all in public use before the date of this patent—that even if it were so, that although the material was before the public, yet the invention was not—that the invention required to be discovered. On the other hand, on the part of the defendant, what is said is this: that the material being in public use, the ready means of the invention were also necessarily before the public; because it is said that the article presented in itself such means of knowledge to the public as to enable any one of ordinary competence to re-produce the article. And if you should come to the conclusion upon the facts that the material was in use before the date of the patent, then the question resolves itself into this,—what is your opinion as to whether the publication of the material was substantially a publication of the invention? If you should find that the material was in public use, but that, notwithstanding it were so, the invention remained still a matter to be discovered, why then, in my opinion, the plaintiff's case would not be affected by the circumstance of the material being in public use. But if, on the other hand, you should think not only that the material were in public use (and I should here say that I do not think it is necessary the use should be actually for sale,—if it were in public use, it need not be sold—it would be sufficient, for instance, if it were in use, handed about the country for the purpose of attracting customers),—if you should think also that, the material being so in use, it was so palpable how you could make it when you got the material, that substantially the disclosure of the material was a disclosure of the means of making it,—if you do not think that, then I think the plaintiff's case is unaffected by the circumstance of the material being before the public in the way I have just been describing to you. That is the second defence as to the question of the novelty.

Then there is another defence, and that is this,—it is said that the plaintiff was not, in fact, in possession of the invention at the date of the patent, which you know was the 21st of November, 1843; but it is said, that he discovered the invention at some period between the date of the patent and the filing of the specification at the end of the six months. Now, if that is so, if you come to that conclusion, I think you must find for the defendants; because the plaintiff seems to me to be in this dilemma,—that either he had not, as he alleges, the invention patented at the date of his patent; or if it is to be said, "yes he had, because though he had not the more extended invention, he had an invention at the time answering to the description given by the patent;" then he is in this difficulty,—that he has not perfected the invention by the specification required within the six months; because, certainly, the specification goes the full length of the full invention: clearly therefore he would fail upon that. Therefore it comes to be a question, whether you are satisfied or not that the discovery of the invention was at a period not before the date of the patent, but, at the same time, between the date of the patent and the end of the six months when the specification was filed.

Now these are the different questions which you will be so good as to consider and answer separately.

Having told you what the questions are, I will now proceed to recall your recollection to some of the most material evidence, as it seems to me, bearing upon those questions respectively.

A Juror.—Are these questions all to be considered separately?

Mr. Justice Williams.—Certainly. First of all you must consider whether there was an infringement; then I will get you to consider whether it was a novelty, bearing in mind the explanation I have given about whether the invention was a novelty or not; then, thirdly, give your opinion upon whether the plaintiff had discovered the invention at the date of this patent or not? Those are the three questions upon which you must be so good as to give separate answers.

Now, the first person whose evidence is material upon these questions is Mr. Cooper. I take it for granted you do not wish me to read over his evidence as to the nature of the invention, or of what it consisted;—you know the invention consisted in the application of heat to the fabric after it had been impregnated with the sulphur. Now, Mr. Cooper's evidence is material upon the question as to whether the material was such that the article presented such means of knowledge to the public as to enable any man, of ordinary competence, to re-produce the article,—that is what is said on the part of the defendants. What Mr. Cooper says upon that is, "If I had not known of the plaintiff's discovery I could not have discovered, by inspection of the material, how the change was produced. I could have discovered," he says, "by chemical analysis, that it contained sulphur,—that would give me no information how the result had been produced which had effected that change in the constitution of the India-rubber,—the action of heat leaves no traces behind at all." Then he says, he "made an experiment with the various ingredients and caoutchouc, excepting sulphur, by applying heat of 300°: it did not produce a change along with them. I placed a piece of India-rubber in there,—as to that piece the change was produced there. I then mixed sulphur with the other ingredients and applied heat; and then the change was produced, which satisfied me the change was due entirely to the sulphur." Then, upon being cross-examined as to this part of the case, he said, "I should have adopted this or some other similar mode of analysis, if employed to analyze the subject, before November, 1843. I do not think I should have tried what the application of heat would have done synthetically,—that is, to put the materials together again. I cannot say what I should have done in order to combine the elements into a given product,—it is impossible to say. After the mixture of the sulphur and rubber it was not so soluble as before." Then, upon being re-examined, he says, "The analysis did not enable me to discover that heat had been employed at all. Before 1843, I did not know that sulphur had been blended with India-rubber: I know it now; and I know heat may be used to blend them. The application of heat to India-rubber, beyond a certain degree, used to be considered injurious; even the action of the sun, for a few days, was considered injurious. If a specimen was produced to me, and I detected the smell of sulphur, that would not have led my mind at all to the notion that the change had been produced by heat. They call the "change" the effect produced by altering the article from an article which is susceptible of variations of temperature, and which is not elastic, to an article called vulcanized India-rubber, which is most elastic." Therefore the result of this gentleman's testimony is, that he considers, in fact, that the mere having the material, and the means of applying chemical knowledge to that material, would not enable anybody to arrive at the invention on which the plaintiff relies for his patent.

Then Mr. Graham, Professor of Chemistry, gives similar evidence; and he says, "I could not have told by inspection, before I knew the plaintiff's discovery, how the change was produced, nor by analysis, nor by any previous chemical knowledge."

The Foreman.—(After the jury had been consulting a short time.) My Lord, if your Lordship would not at all be offended, I think we could save you a great deal of time.

Mr. Justice Williams.—Certainly, I have not the least wish to detain you, having told you what the questions are.

A Juror.—Will your Lordship have the kindness to write down the three questions to which we should give answers.

Mr. Serjeant Byles.—Perhaps your Lordship will write them down, as the gentlemen require it.

The Foreman.—The first was, as to the infringement; the second, whether the invention was in use.

Mr. Justice Williams.—No. The second is more as to the novelty, bearing in mind what I have already told you about the law on that subject.

Then the third question is this,—there has been a vast deal of evidence upon the question of whether or no the plaintiff, in truth, had discovered the invention as early as the date of his patent. It is said that, by the terms of what is called his deposit, that he at that time did not contemplate using the application of heat; and your attention is called to several other circumstances of early date, as to the date when he first made experiments, and a variety of other matters. I do not know exactly how to deal with the question;—if you have made up your minds, I shall not go into the evidence at all; or if I go into it partly, I must go into it entirely. The third question is,—whether you think the plaintiff was in possession of the discovery of the invention at the date of the patent; or, as it is said, on the part of the defendants, whether he discovered it at some period between that date and the end of six months, when unquestionably he had it, because he specified it? If you have made up your minds upon it, I need not trouble you.

A Juror.—Would your Lordship have the kindness to give us the date of the witness, Woodcock's, experiment?

Mr. Justice Williams.—He gives it rather loose,—he puts it that it was February or so.

Mr. Serjeant Byles.—In the spring, he says.

Mr. Justice Williams.—In the spring,—February or so.

Mr. Serjeant Channell.—That he did them at Manchester.

Mr. Justice Williams.—The earliest proof of an experiment is the one which Woodcock speaks to, which he puts February or so: that is the earliest of any that I am aware of. If the learned counsel can name any earlier one he can do so.

Mr. Serjeant Channell.—He says he completed it in February or March, at Manchester, under Mr. Hancock's direction.

Mr. Justice Williams.—1844, of course?

Mr. Serjeant Byles.—I have turned to my note, and it is this: "Early in the spring of 1844, I was directed to make experiments;" possibly your Lordship would read that part to the jury.

Mr. Serjeant Channell.—You must read the whole of it,—it was not to make experiments, it was to complete them.

Mr. Serjeant Byles.—My note is this: "Early in the spring of 1844, I was directed to make experiments." We shall see what my Lord's note is,—it is in his cross-examination, which I think was by the Attorney-General.

Mr. Justice Williams.—"It was early in the spring of 1844, probably February or so, that the plaintiff desired me to make experiments."

Mr. Serjeant Channell.—He was to make them at Manchester. Mr. Hancock had made them in London.

Mr. Serjeant Byles.—There is no evidence of the experiments in London.

Mr. Justice Williams.—He said that Hancock had no means of making extensive experiments himself;—he only had a laboratory, which opened from his bed-room at Stoke Newington.

Mr. Serjeant Channell.—That was a question put by the Attorney-General; my impression is, in the re-examination he described Hancock's experiments in London, and afterwards he worked them out.

Mr. Justice Williams.—Stop, gentlemen; one of the gentlemen has raised a question,—I am anxious it should be put right: tell me, brother Channell, what part you refer to. I paid particular attention to try and find a date on my note; and that is the only date I can find. If you will draw my attention to any other I shall feel obliged?

Mr. Serjeant Channell.—There is no other date; that is the date he gave to us; there were other circumstances he gave, that Mr. Hancock had been working in London.

Mr. Serjeant Byles.—Where is there any evidence of Mr. Hancock working in London before that?

Mr. Serjeant Channell.—Over and over again;—then at Manchester he performed the act, not the experiment.

Mr. Serjeant Byles.—In whose evidence is that, brother Channell, I see none in Woodcock's evidence.

Mr. Serjeant Channell.—You merely state the question which the Attorney-General put in cross-examination.

Mr. Serjeant Byles.—It was not so; it was the gentlemen of the jury asked when it was,—that is the only evidence that it was early in the spring of 1844.

Mr. Justice Williams.—In the examination in chief, what he says is this: "Before the specification was enrolled, the plaintiff had informed me of his invention, and told me to make experiments; we had extensive opportunities at Manchester for making them which he did not possess; he had only a small laboratory, opening out of his bed-room at Stoke Newington: I followed his directions."

Mr. Serjeant Byles.—He is interrogated more closely as to the date.

Mr. Justice Williams.—That is the examination in chief; then, in cross-examination, he says that is the date.

The jury retired about a quarter to five o'clock, and returned into Court at five o'clock.

Mr. Justice Williams.—How do you say, gentlemen, first as to the infringement?

The Foreman.—That the patent was infringed.

Mr. Justice Williams.—How do you find as to the novelty?

The Foreman.—That the invention was not in use before the date of the patent.

Mr. Justice Williams.—How do you find the third,—whether the plaintiff had discovered the invention before the date of the patent?

The Foreman.—We find he had; that is, finding a verdict generally for the plaintiff.

Mr. Serjeant Channell.—Will your Lordship grant the usual certificates?

Mr. Justice Williams.—Forty shillings damages.

Mr. Webster.—Three certificates, my Lord.

The Associate.—You want a certificate as to the validity of the patent.

Mr. Serjeant Channell.—A certificate for a special jury, to avoid the operation of the County Court, and that the validity of the patent came into question.

The Associate.—You do not want a third, one will do both; you cannot try a patent case in the County Court.

Mr. Webster.—There are three certificates wanted.

Mr. Hindmarsh.—I am to apply to your Lordship for a certificate that the deposit paper was duly proved before your Lordship, in pursuance of the Judge's order; his Lordship's order was, if the deposit paper was proved.

Mr. Justice Williams.—Which deposit paper?

Mr. Hindmarsh.—The deposit paper of the plaintiff.

Mr. Serjeant Channell.—That is for his Lordship to say: we shall not argue that.

Mr. Justice Williams.—Yes, certainly.

List of Patents

Granted for SCOTLAND, subsequent to 22nd June, 1851.

To John Swindells, of Manchester, in the county of Lancaster, manufacturing chemist, for certain improvements in obtaining products from ores and other matters containing metals, and in the preparation and application of such products for the purposes of bleaching, printing, dyeing, and color making.—Sealed 25th June.

John Emmanuel Lightfoot, of Broad Oak, Accrington, in the county of Lancaster, calico printer, and James Higgin, of Cobourg-terrace, Stratford-road, Manchester, in the same county, chemist, for improvements in treating and preparing certain coloring matters, to be used in dyeing and printing.—Sealed 26th June.

Robert Hayes Easum, of Commercial-road, Stepney, in the county of Middlesex, rope-maker, for improvements in the manufacture of rope.—Sealed 1st July.

George Frederick Muntz, the younger, of Birmingham, in the county of Warwick, Gent., for improvements in furnaces applicable to the melting of metals for making brass, yellow metal, and other compound metals.—Sealed 2nd July.

Thomas Allan, of the City of Edinburgh, Gent., for certain improvements in electric telegraphs, and in apparatus connected therewith.—Sealed 2nd July.

Thomas Hawkins, of Inverness-terrace, Bishop's-road, Bayswater, in the county of Middlesex, oilman, for improvements in brushes.—Sealed 16th July.

John Brazil, of Manchester, in the county of Lancaster, Gent., for certain improvements in dyeing, and in the preparation of dye woods.—Sealed 21st July.

John Platt, of Oldham, in the county of Lancaster, engineer, and Richard Burch, of Heywood, in the same county, manager, for certain improvements in looms for weaving.—Sealed 21st July.

Percival Moses Parsons, of Robert-street, Adelphi, in the county of Middlesex, civil engineer, for improvements in cranes capable of being used on railways, and in parts of railways.—Sealed 21st July.

New Patents

SEALED IN ENGLAND.

1851.

To John Brazil, of Manchester, Gent., for certain improvements in dyeing, and in the preparation of dye-woods. Sealed 24th June—6 months for inrolment.

Richard Edward Hodges, of Southampton-row, in the county of Middlesex, Gent., and William Brockedon, of Devonshire-street, in the same county, Gent., for improvements in surgical instruments. Sealed 24th June—6 months for inrolment.

Alexander Parkes, of Birmingham, for improvements in separating silver from other metals. Sealed 24th June—6 months for inrolment.

George Jordan Firmin, of Lambeth-street, Goodman's Fields, in the county of Middlesex, manufacturing chemist, for improvements in the manufacture of oxalate of potass. Sealed 24th June—6 months for inrolment.

John Holmes, of Birmingham, in the county of Warwick, machinist, for improvements in machinery for cutting and stamping metals. Sealed 24th June—6 months for inrolment.

John Platt, of Oldham, in the county of Lancaster, engineer, and Richard Burch, of Heywood, in the same county, manager, for certain improvements in looms for weaving. Sealed 3rd July —6 months for inrolment.

James Howard, of the Britannia Iron Works, Bedford, agricultural implement maker, for improvements in ploughs and other implements, or machines used in the cultivation of the soil. Sealed 3rd July—6 months for inrolment.

John Aston, of Birmingham, manufacturer, for improvements in buttons and ornaments for dress, and the machinery for making the same, respectively,—being a communication. Sealed 3rd July—6 months for inrolment.

Charles Payne, of the Wandsworth-road, in the county of Surrey, Gent., for improvements in drying animal and vegetable substances; and in heating and cooling liquids. Sealed 3rd July—6 months for inrolment.

George Kemp, of Carnarvon, North Wales, Doctor of Medicine, for a new method of obtaining motive power by means of electro-magnetism. Sealed 3rd July—6 months for inrolment.

Richard Jex Crickmer and Frederick William Crickmer, of Page's-walk, Bermondsey, engineers and co-partners, for improvements in packing stuffing-boxes and pistons. Sealed 3rd July—6 months for inrolment.

Charles Cowper, of Southampton-buildings, Chancery-lane, in the county of Middlesex, for improvements in the preparation of cotton for dyeing and bleaching,—being a communication. Sealed 3rd July—6 months for inrolment.

Robert Hayes Easum, of Commercial-road, Stepney, in the county of Middlesex, rope-maker, for improvements in the manufacture of rope. Sealed 3rd July—6 months for inrolment.

William Hamer, of Manchester, for certain improvements in looms for weaving. Sealed 3rd July—6 months for inrolment.

Charles Barlow, of Chancery-lane, London, Esq., for improvements in rotary engines. Sealed 3rd July—6 months for inrolment.

Frederick Rosenborg, of the Albany, in the county of Middlesex, Esq., for improvements in the manufacture of casks, barrels, and other like articles; and the machinery employed therein. Sealed 5th July—6 months for inrolment.

Henry Craven Baildon, of Edinburgh, Scotland, chemist, for improvements in writing, printing, or marking letters, characters, or figures, upon paper, parchment, or other material properly prepared for that purpose. Sealed 7th July—6 months for inrolment.

James Buchanan Mirrlees, of Glasgow, N. B., engineer, for certain improvements in machinery, apparatus, or means for the manufacture or production of sugar. Sealed 7th July—6 months for inrolment.

Thomas Wilks Lord, of Leeds, in the county of York, flax and tow machine-maker, and George Wilson, director of the flax works of John Fergus, Esq., M.P., of Prenlaws, in the county of Fife, N. B., for a machine to open and clean tow and tow waste from flax, hemp, and other similar fibrous substances;

and an improved mode of piecing straps and belts for driving machinery; and a machine for effecting the same,—being a communication. Sealed 17th July—6 months for inrolment.

John Hick, of Bolton-le-Moors, in the county of Lancaster, engineer, for his invention of certain improvements in steam-boilers or generators. Sealed 17th July—6 months for inrolment.

Thomas Sanders Bale, of Cauldon-place, in the county of Stafford, china manufacturer, for certain improvements in the method of treating, ornamenting, and preserving buildings and edifices; which said improvements are also applicable to other similar purposes. Sealed 17th July—6 months for inrolment.

William Dickinson, of Blackburn, in the county of Lancaster, machine maker, and Robert Willan, of the same place, mechanic, for certain improvements in machinery or apparatus for manufacturing textile fabrics. Sealed 17th July—6 months for inrolment.

John Mc Nab, of Midtownfield, in the county of Renfrew, N. B., bleacher, for certain improvements in stretching and drying textile fabrics or materials; and in the machinery or apparatus employed therein. Sealed 17th July—6 months for inrolment.

Arthur Albright, of Birmingham, in the county of Warwick, manufacturing chemist, for improvements in the manufacture of phosphorus; and in the apparatus to be used therein. Sealed 17th July—6 months for inrolment.

Arthur Field, of Lambeth, Gent., for improvements in the manufacture of candles, night-lights, and mortars. Sealed 22nd July—6 months for inrolment.

Samuel Varley, of Sheffield, engineer, for improvements in retarding and stopping railway carriages; and in making communications between the guards and engine-drivers on railways. Sealed 22nd July—6 months for inrolment.

Thomas, Earl of Dundonald, Admiral in Her Majesty's Navy, of Chesterfield-street, in the county of Middlesex, for improvements in the construction and manufacture of sewers, drains, water-ways, pipes, reservoirs, and receptacles for liquids or solids; and for the making of columns, pillars, capitals, pedestals, vases, and other useful and ornamental objects, from a substance never heretofore employed for such manufacture. Sealed 22nd July—6 months for inrolment.

James Timmins Chance, of Birmingham, Gent., for improvements in the manufacture of glass,—being a communication. Sealed 28th July—6 months for inrolment.

Richard Lloyd, of Paris, in the Republic of France, engineer, for improvements in steam-engines, and in heating steam.—being a communication. Sealed 28th July—6 months for inrolment.

CELESTIAL PHENOMENA FOR AUGUST, 1851.

D.	H.	M.	
1			Clock before the ☉ 6m. 3s.
—			☽ rises 9h. 17m. M.
—			☽ pass mer. 3h. 48m. A.
—			☽ sets 10h. 4m. A.
	20	55	♃ in conj. with the ☽ diff. of dec. 4. 19. S.
4	5	7	☽ in □ or first quarter
5			Clock before the ☉ 5m. 46s.
—			☽ rises 2h. 17m. A.
—			☽ pass mer. 7h. 10m. A.
—			☽ sets 11h. 46m. A.
7	3	49	Pallas in □ with the ☉
9			Juno stationary
	19	12	♅ stationary
10			Clock before the ☉ 5m. 10s.
—			☽ rises 7h. 7m. A.
—			☽ pass mer. 11h. 25m. A.
—			☽ sets 2h. 47m. M.
11			Occul. γ Capricorni, im. 12h. 41m.
—			Occul. δ Capricorni, im. 16h. 50m. em. 17h. 18m.
11	9	43	Ecliptic oppo. or ○ full moon
	23	43	☿ in the descending node
13			Occul. ψ3 Aquarii, im. 15h. 20m. em. 15h. 55m.
	22		☽ in Apogee
15			Clock before the ☉ 4m. 19s.
—			☽ rises 9h. 7m. A
—			☽ pass mer. 2h. 23m. M.
—			☽ sets 8h. 7m. M.
17			Mercury, R. A., 11h. 20m. dec. 3. 26. N.
—			Venus, R. A., 8h. 59m. dec. 18. 3. N.
—			Mars, R. A., 5h. 24m. dec. 23. 5. N.
—			Vesta, R. A., 16h. 52m. dec. 22. 0. S.
—			Juno, R. A., 16h. 52m. dec. 7. 18. S.
—			Pallas, R. A., 3h. 21m. dec. 4. 14. S.
—			Ceres, R. A., 5h. 45m. dec. 21. 24. N.
17			Jupiter, R. A., 13h. 12m. dec. 6. 29. S.
—			Saturn, R. A., 2h. 11m. dec. 10. 32. N.
—			Uranus, R. A., 2h. 9m. dec. 12. 30. N.
—			Mercury pass mer. 1h. 39m.
—			Venus pass mer. 23h. 19m.
—			Mars pass mer. 19h. 42m.
—			Jupiter pass mer. 3h. 31m.
—			Saturn pass mer. 16h. 28m.
—			Uranus pass mer. 16h. 25m.
	7	19	♄ stationary
	10	17	Vesta in conj. with Juno, diff. of dec. 14. 4. S.
17	15	8	♅ in conj. with the ☽ diff. of dec. 4. 57. N.
	16	28	♄ in conj. with the ☽ diff. of dec. 2. 45. N.
20	0	58	☽ in □ or last quarter
21	17	17	♂ in conj. with the ☽ diff. of dec. 2. 40. N.
22	3	32	☿ in Aphelion
24			Occul. δ Cancri, im. 14h. 35m. em. 15h. 14m.
	4	53	♀ in the ascending node
25			Clock before the ☉ 2m. 1s.
—			☽ rises 2h. 38m. M.
—			☽ pass mer. 10h. 42m. M.
—			☽ sets 6h. 32m. A.
	9		♀ in Perihelion
	17	42	♀ in conj. with the ☽ diff. of dec. 1. 13. S.
	22	33	☿ greatest elong. 27. 13. E.
26	10	20	Ecliptic conj. or ● new moon
	23	0	☽ in Perigee
27			Vesta in the descending node
28	2	46	☿ in conj. with the ☽ diff. of dec. 7. 47. S.
29	12	35	♃ in conj. with the ☽ diff. of dec. 4. 22. S.
30			Clock before the ☉ 0m. 36s.
—			☽ rises 9h. 38m. M.
—			☽ pass mer. 3h. 21m. A.
—			☽ sets 8h. 53m. A.

Eclipses of Jupiter's Satellites are not visible this month.

J. LEWTHWAITE, Rotherhithe.

THE
LONDON JOURNAL,
AND
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OF
Arts, Sciences, and Manufactures.

CONJOINED SERIES.

No. CCXXXVII.

THE INDUSTRIAL EXHIBITION.

GENERAL REMARKS.

When the humble critic, in the faithful pursuit of his calling, finds himself irresistibly led on to perform the part of a censor, he has no option but to follow one of two courses,—either to belie his judgment by writing contrary to its dictates, or to state what he believes to be the truth, however unpalatable it may be. In availing ourselves of the present opportunity of comparing the products of industry of different nations, for the purpose of determining their relative merits, we are but carrying out the main design of the projectors of the Great Exhibition; and, unless such comparisons are made in a calm temper, and with a sincere wish to arrive at the simple truth, they will altogether fail of their use, and perhaps tend to confirm existing prejudices, which may be already sufficiently strong to blind the judgment—on the one hand to the presence of merit, and on the other to the absence of skill. It is scarcely, therefore, good policy to leave the pages of the great book of practical knowledge which the Exhibition presents, to the exclusive reading of those whose business it is to gather in and practically apply the information laid open to them; on the contrary, there seems to be a special call for the critic, who is untramelled by trade traditions, to step forward and plainly and honestly point out to the manufacturer his strength and his weaknesses. We are the more encouraged to pursue this course, although our remarks must occasionally wound the pride of British manufacturers, because it is as marked a peculiarity in the English as it was in the old Roman character, to make available the experience gained by every defeat:—to know therefore when we are beaten is of service in an amicable contest like the one we have courted in the several branches of the peaceful arts; whatever may be the advantage of ignorance on that point in martial enterprises.

In reviewing, in the present number, under the head *Raw Materials*, the practice of the potter in preparing his clay, we have taken occasion to note the inferiority of the British to the foreign ware, not so much in its appearance (for that has been already treated of under the head *Decorative Art*) as its consistency and durability; but, besides pointing out the cause of the defect, a means of remedying it is indicated: we trust therefore that our strictures will be received in good part by the manufacturers, and that they may lead to the speedy introduction of improvements in that important branch of industry. Again, under the head *Musical Instruments*, the tardy introduction of improvements in organ building has been adverted to; and, although the recent advance made in this art in Great Britain by a few individuals, has saved the credit of the country in this particular, yet, on a careful consideration of the state of the trade generally, we feel bound to admit the superiority of France and Germany in organ building. In many branches of the arts England holds an unquestionable superiority; but even in these our manufacturers are always ready to receive suggestions for still further improvements; we trust, therefore, that no false pride will prevent those who are engaged in the prosecution of manufactures which are excelled in by foreign countries, from adopting the only means that discretion would dictate; so that, at the next gathering of the nations (if such should ever occur), our industry and skill may shew better comparative results in all divisions of labor which it is properly the province of our artists and artisans to pursue.

In speaking of *Decorative Art*, we have shewn, and fear, as we proceed with our examination, it will be necessary to repeat our caution—that there is more to unlearn than to learn, both among English and foreign manufacturers: there is evidence here of a straining after false effects; and the coincidence of efforts among the artists of different countries can operate in no other way than to confirm them in their present notions. We are sorry to hear, as a confirmation of our view of the ill effects likely to arise to decorative art from the Great Exhibition, that large orders have been received by the most skilful of the contributors of picture paintings on glass,—the inherent defects of which style were pointed out in our last number.

The present number contains the first of a series of papers on Agricultural Implements, which subject presents to us the pleasing task of noticing a healthy progress at every step of our inquiry.

RAW MATERIALS.

CLAY AND THE POTTERY MANUFACTURES.

The intimate connections which exist geologically between coal and its superincumbent strata of clay slate and clay, lead us next to investigate the various forms of alumina present amongst the mining and mineral products of the Great Exhibition. In this respect Class I. will be found to yield a large and instructive field of inquiry; for almost every kind of commercial clay is here displayed, both in its raw or primitive state, as dug out of the pit, and also in the semi-manufactured form best suited to the market. Since these clays constitute, as we shall presently shew, no inconsiderable item of our national wealth, it is somewhat singular that their exact composition should hitherto have attracted so little notice from the scientific world, more especially as a knowledge of their chemical properties would seem to lay open their geological history, and form the materials for one of the most useful and popular works of the day. Nevertheless, so it is, that the exact composition of these clays remains yet to be determined. A strong corroboration of the truth of this assertion is found in the fact that, although it must evidently be to the interest of those exhibitors in this line, by whom the best and purest articles are shewn, to afford every information regarding the constitution of their goods, yet, in no one instance, is the chemical composition of a single sample of clay so much as alluded to throughout the entire Exhibition. The injurious effect of this ignorance will, bye and bye, come under consideration, when speaking of the art of the potter; but, for the present, we shall content ourselves with a hasty glance at the various specimens of clay contained in Class I.,—adding, as usual, a few practical hints for the analysis of these substances, together with the results of some analytical investigations, recently made upon average market samples of clay, for the express purpose of elucidating this obscure subject. In a manufacturing point of view, clays may be conveniently divided into three classes; for although a fourth (that is to say, common marl clay) exists, yet, as its employment is limited to the making of bricks, and other coarse articles, in which improvement is nearly hopeless, so far as regards material, we shall confine our observations to the three finer qualities, named, respectively, china clay or kaolin, fire-clay, and potter's clay. In china clay, Jenkins and Courtney, of Truro; Whitley, of Truro; C. Thriscutt, of St. Austell; the West of England China Stone and Clay Company; Truscott, Martyn, Brown, Michell, and Wheeler, Philip, & Co., all of St. Austell; and W. Phillips, of the Morley Works, near Plympton; together with Sir G. Hodson, Bart., of Wicklow, in Ireland, exhibit some samples of great beauty and apparent purity. In fire-clay, the articles shewn by King and Co., Squires and Son, and F. T. Rufford, of Stourbridge, with those from Cowan and Co., Ramsey and Co., and Potter, of Newcastle, are excellent; and a sample from Pease, of Darlington, also deserves notice. In potter's clay, Whiteway, Watts, and Co., of Dorset; Fayle and Co., of Thames-street, London; W. and J. Pike, of the Isle of Purbeck; N. Burnet, of Gateshead; and the North Devon Pottery Company, are the most remarkable, though there are many very respectable looking samples from other quarters.

In the manufacture of earthenware goods, it is indispensably necessary to mix the clay, in the first instance, with some infusible material, which does not contract or diminish under the influence of heat; for all kinds of clay shrink very much by the action of a high and prolonged temperature, and are therefore liable, during such exposure, to warp and twist out of shape, or become cracked in the furnace. Hence, a remedy is sought, as above indicated; and, for this purpose, silica, in a minute state of division, is generally preferred; though felspar and a kind of decomposing granite, called Cornish stone, are also used. But whatever may be the material, its introduction into the body of the earthenware is conducted on purely empirical principles; for, as the composition of the clay is unknown, no attempt can be or is made to effect a combination in unison with the laws of chemical affinity. The substances employed are recognized only as clay, and perhaps ground flint; nor is any other test used to ascertain the proper proportion of each towards the other, than the uncertain judgment of a workman, or the equally fallacious practice of an established rule. As, however, all clays, in a state of natural purity, consist of silica and alumina, united together in definite atomic proportions, there can be no doubt that perfection in earthenware depends upon this simple law; and that the only true mode of fabricating a uniform and really valuable kind of pottery-ware would be to follow out the indications of nature, and constantly preserve an atomic ratio in the admixture of the flint and clay of which that pottery-ware is composed. Of course, under existing circumstances, this is impossible; for, as we have previously remarked, the precise composition of the different clays used in the arts is totally unknown; and, independent of any chemical difficulties that may be presumed to exist in determining this important fact for themselves, our manufacturers may justly plead that no simple and satisfactory mode of analyzing clay has yet been published. Hence, the present empirical system is universal; and the accidental admixtures it produces testify to the truth of our remarks, by cracking and flying to pieces under very trivial alterations of temperature, no less to the annoyance than loss of the public at large. Nor can this be wondered at, when it is remembered that, in almost every tea-cup, saucer, or plate upon our tables, the laws of natural combination have been violated by the prevalence of an artificial and incompatible form of arrangement,—the work of sheer ignorance and chance. So far as our investigations have yet gone, it appears that kaolin, or china clay, has arisen from the decomposition of felspar under two different conditions; for the resulting compound is not alike in both cases; though to what cause this difference can be ascribed, we are unable with certainty to say. Felspar, in its original state, has exactly the same composition as anhydrous alum, with this exception, that in the one case the bases are united to sulphuric and in the other to silicic acid. Felspar, therefore, consists of one atom of potash and one of silica, united to two atoms of alumina and three of silica; or, in other words, it is formed of the silicate of potash and the silicate of alumina, combined in the ratio of one atom of the former to two of the latter. Now, it is found that, when felspar is long exposed to the action of the weather, it becomes disintegrated, and falls into a state of powder, which, ultimately, by absorbing water, assumes a pasty consistence, and thus forms the article called china clay. The nature of this decomposition is not, however, uniform or invariable; for analysis proves that the residuary product has not always the same composition. When felspar decomposes in an absolutely wet or rainy atmosphere, the silicate of potash would appear to be simply washed away by the excess of water; and, in this case, the resulting clay has a composition of three atoms of silica and two of alumina; but, when merely a moist atmosphere has existed, then the silicate of potash itself seems to become decomposed, probably by carbonic acid; thus leaving the whole of the silica united to the alumina,—the potash then escaping as a carbonate. Under such circumstances, we have found china clay to consist of four atoms of silica and two of alumina; or, what is the same thing, of two of acid and one of base. Of course an alternating atmosphere would produce a mixture of these; and such layers may actually be traced in many specimens of clay, as though the summer and winter portions of the year had each furnished a distinctly separate amount of decomposed felspar. But felspar is not the only source from whence our silicates of alumina have been formed; as there are many other minerals which, by the action of the atmosphere, furnish clays of different compositions: thus the substances known to mineralogists under the names leucite, albite, analcime, nepheline, mesotype, and sodalithe, all yield silicate of alumina, which contains, indeed, various proportions of the two ingredients, but is, nevertheless, in a commercial sense, clay. In point of fact even granite has contributed its quota to the clay formation; for though slowly and imperfectly, yet, in time, it crumbles down into supersilicate of alumina; as may be noticed by carefully examining the once smooth surface of the granite on Waterloo and London Bridges, which is gradually assuming a cavernous character. With such evidence before us of the infinite variety existing in clay, it is surely high time that the attention of manufacturers was directed to the necessity of analyzing this substance, and adding to it neither more nor less silica than is sufficient to produce a useful atomic compound. The proper proportion might soon be arrived at by a few carefully conducted experiments; after which the whole of the uncertainty now connected with differences in the material would vanish for ever, and with it no small amount of the loss occasionally caused by earthenware spoilt or broken in the kiln.

To determine the quantity of alumina in clay, a given weight of this substance, say 100 grs., well dried and in fine powder, should be mixed with double its weight of fluor spar, also in fine powder; then place the mixture in a platinum or leaden vessel, and pour over it about 400 grs. of strong sulphuric acid; next expose the whole to a heat of from 212° to 250° Fahr. for half an hour; then add three or four ounces of water, and throw the mixture on a filter,—adding a little water at the end of the filtration, so as to obtain the whole of the soluble matter. To the filtered fluid add now an excess of a solution of ammonia, by which the alumina will be precipitated; and this, after being well washed on a filter, and dried at a red heat, must have its amount determined by the balance. If, however, the precipitate, thrown down by ammonia, has a deep yellow or red color, the presence of iron is indicated; and this must be removed before drying the alumina. For this purpose, a quantity of tartaric acid should be added, so as to re-dissolve the mixed precipitate, and the solution slightly supersaturated with carbonate of soda; when, on adding hydrosulphate of ammonia, the iron will separate as a black sulphuret, leaving the alumina still in solution; from whence it may be obtained by evaporating the whole to dryness, heating red hot, and then washing away the alkaline salts by hot water: the alumina is then left pure, and, after being dried, may be weighed. As the presence of iron in clay is a serious drawback, the quantity of black sulphuret formed becomes a good indication of the impurity of the sample under examination, and is therefore worthy of notice.

Although the proportion of alumina in clay is the chief commercial feature required by the makers of earthenware, yet it may sometimes be requisite to determine also the amount of silica present: which may be done by fusing together, in an iron crucible or pan, at a full red heat, one part of the clay in question with three parts of pure potash,—both being in fine powder, and carefully mixed before fusion. The fused mass must, when cold, be boiled for some time in water, until it is thoroughly disintegrated; when it should be poured into a porcelain vessel, and supersaturated with muriatic acid; after which, by evaporating to dryness, a residue will be obtained that, after careful washing with boiling water, consists merely of the silica contained in the clay in question. After being heated red hot, it may be weighed as usual. If lime be suspected to exist with the alumina in clay, this may be separated, when in solution, by means of tartaric acid and carbonate of soda, as above indicated; for, in such a case, the lime will fall at once as a carbonate, leaving the alumina behind in the fluid. Independent, however, of the defects in British earthenware, due to the non-atomic admixture of its ingredients, there are others arising out of the nature of the ingredients themselves; so that, taken as a whole, we cannot avoid coming to the unpleasant conclusion that, in the great arena of competition at the Crystal Palace, we are decidedly beaten in the manufacture of fine earthenware, even by countries greatly our inferiors in capital, intelligence, and natural resources. France, Germany, Sweden, Denmark, Spain, Russia, Turkey, and China, all exhibit porcelain of a quality unmatched by anything in the British department; and no more lamentable contrast could possibly be drawn than between the chemical apparatus from Saxony and the clumsy abortions which, under that name, disfigure some of the compartments claimed by one or two of our Worcester manufacturers. In the one case we find a really handsome, light, and elegant article, the glaze of which has evidently penetrated throughout the entire substance of the body, and converted the whole into a uniform vitrification; in the other a thick, coarse, opaque, and spongy mass, is merely glazed over on its extreme surface by a fusible compound, having no properties in common with the body of the article, and endowed with very different powers of expansibility by heat; so that, after being used a few times, the glaze becomes cracked and shivered in a thousand directions, as may be seen by examining the earthenware in common use throughout Great Britain. Nor is the unsightly appearance, caused by this cracking of the glaze, the whole evil; for earthen vessels, thus flawed, acquire the property of absorbing fluids into their pores, and can never afterwards be thoroughly cleaned. In spite, therefore, of "warranted not to absorb," and other groundless legends of similar import, imprinted upon many British goods, a piece of really non-absorbent earthenware, for common use, is an actual curiosity in this country, and invariably suggests the idea of a foreign origin. Now this defect can be remedied only in two ways; and as our manufacturers have vainly endeavoured to carry out, practically, one of these ways, we are not without hopes of persuading them to try the other. If a glazing material could be discovered, the expansions and contractions of which, by heat, exactly corresponded with those of the biscuit ware, or silicate of alumina, under the same influence, then the present system of covering a spongy body by a coating of vitrifiable glaze would answer the desired intention well enough; for to the cheapness and durability of earthenware, would thus be superadded the cleanliness of glass. But this desideratum has been sought for, over and over again, during the last half century; and nothing but disappointment has resulted. In proof of which we have only to ask—where is that glazed earthen vessel which, though made expressly for the use of the apothecary, will retain oil, after being two or three times heated and cooled? The answer to this question must be our argument in favor of abandoning such a system of glazing, and adopting the only other mode by which a non-absorbent pottery-ware can be fabricated. The body of the ware itself must undergo a semi-vitrification, as happens with the finest kind of china; so that even if, by long use, the glaze came to be fairly worn off, still the non-absorbent principle would remain as perfect as at first. We know that this is impracticable under existing circumstances; and that, so long as the present empirical mode of compounding the materials, of which the body of the ware is made, continues, no chance of improvement remains. A mixture of silica and alumina, in the proportion of four atoms of the former to one of the latter, would bear or require a certain quantity of fusible material to induce semi-vitrification throughout the mass;

but a compound of three atoms of silica and one of alumina would probably be melted down into a worthless slag, by exactly the same addition. Here then lies the root of that difficulty which has hitherto so injuriously restricted the employment of felspar, and other vitrifiable bodies, in the fabrication of British earthenware. Those who have attempted to use such substances have occasionally succeeded to admiration; and nothing but the uncertainty of the result, and repeated failures, have induced them to abandon the employment of a class of articles which, if capable of being controlled, every intelligent manufacturer admits would confer perfection on his art. But it is a great mistake to suppose that these inequalities of action arise out of some peculiarity in the vitrifiable materials themselves, or are in any way the work of chance. The materials are, or ought to be, uniform, and certainly can be made so; whilst, for the rest, there is no such thing as chance in nature,—the laws of chemistry are not accidental or variable, they are immutable. We have shewn, however, that clays not only differ from each other, but, as it were, from themselves; since, from the same pit, and within a few inches of the same spot, clays of very contrary characters may be procured. Plasticity is no more an indication of the presence or purity of clay, than sweetness is a test of sugar. In a rough way, both these qualities have a value; but the arts are now fast approaching an epoch when all such fallacious aids must give place to the guidance of philosophy; and the sooner our manufacturers become convinced of this grand truth, the better for themselves and their country.. The propriety of knowing the exact composition of the raw materials employed in any art or manufacture does not indeed admit of dispute—it is imperative; and hence we are the more astonished at the paucity of information respecting the analysis of so important a production as clay. In face of such apathetic ignorance, would any one believe that, independently of an immense home consumption, our exports of earthenware last year amounted to a million sterling? Had the clays of this country been of a tolerably uniform composition, like some of those in China and on the continent, of course mere practice would long ago have enabled our potters to produce articles of the highest quality. But surely this is a sorry compliment to men surrounded by all the resources of science and capital. Where there is no difficulty there can be but little merit, and still less profit. It is the great glory of British enterprise and industry to despise so tame and facile a position. Our manufacturers must meet and overcome the trivial impediments connected with variations in the clay they purchase, and, by properly adjusting the other materials (so as to bring on exactly the due amount of vitrification needed in the body of the ware), produce, from any kind of clay, articles identical with those which other nations fabricate from the very finest clays only. With the prodigious commercial and other advantages possessed by Great Britain, the world at large ought to expect this at our hands, and not the sub-mediocre display now contained in the Great Exhibition.

Before quitting this subject, a few remarks upon the substances used in the formation of glazes may not be inappropriate. The million is still supplied with earthenware, the glaze of which contains lead, and is, consequently, dangerous to health,—though, when well burnt on, this danger is greatly diminished, from the increased insolubility of the silicate of lead in weak acids. It is, however, an objectionable mode of glazing earthenware, and requires to be watched with caution, more especially where borax is used at the same time,—for the borate of lead is more easily acted on than the silicate. It has been lately suggested, that oxide of zinc would form a sufficiently fusible compound with silica, and is cheap enough to supplant oxide of lead in the glazing of common earthenware. The latter assertion is undoubtedly true, and, although we entertain some suspicion as to the easy fusibility of silicate of zinc, yet this is precisely one of those problems which, from their important sanitary bearing, deserve immediate investigation. On the continent a very pure kind of felspar, mixed probably with a little carbonate of baryta and oxide of tin, forms the only glaze used upon porcelain and the china vessels intended for chemical purposes. This glaze is practically perfect. It is so hard as to withstand the attack of a file, and resists the action of the strongest acids and alkalies at all temperatures below 300° Fahr.,—the hydrofluoric acid and its salts alone excepted. In the French, Saxon, and Prussian departments of the Crystal Palace, there are several good specimens which illustrate the value of this kind of glaze.

Amongst the English goods—and chiefly those from Staffordshire—may be seen a variety of articles made in what is termed Parian, a compound, the unfitness of which for statuary purposes we have had occasion to notice in our observations on Decorative Art. The employment of this material, or, indeed, any other form of alumina where sharpness and symmetry are wanted, cannot be sufficiently condemned, since it is totally contrary to the natural properties of alumina, and betrays infinite ignorance regarding first principles. The philosophical mind of Wedgewood would have revolted at so palpable an absurdity; for not alone was he well acquainted with the continuous contractility of aluminous compounds, but, taking advantage of that knowledge, he was able to construct an instrument for measuring high degrees of heat, which, although not rigidly perfect, is, at this day, still found the only available guide for furnace operations on a large scale. And the value of this instrument or pyrometer, as it is termed, depends upon the fact, that the longer and higher the temperature to which clay is exposed, the smaller it becomes. Now, bearing in mind that earthenware is an extremely bad conductor of heat,—let us imagine the Greek Slave, for example, correctly modelled in clay or Parian, and subjected to the heat of a porcelain furnace. The smaller portions of the figure, as the nose, eyelids, fingers, &c., would receive much more of the impress of the fire than the larger ones—as the head, shoulders, &c.;—consequently, however symmetrical the original model might have been, the extra contraction in the smaller parts must destroy every thing like anatomical harmony and beauty. The fingers would become short and dumpy, and the nose flat and snubbed. But this is a small part of the mischief, for since clay, when burnt, is a bad conductor of heat, and the action of the fire is from without to within, the exterior of the figure must contract vastly more than the interior;—consequently, the outside becoming too small for the inside, a series of cracks or fissures make their appearance to compensate for the inequality. These, of course, are filled up by a subsequent operation; but, it is needless to add, at the expense of everything which would have rendered the result valuable as a work of art. The general appearance of the Parian figures shewn in the Exhibition bears us out in this censure; for the features are universally flat, soulless, and devoid of expression; nor can we imagine a more hopeless task than attempting to remedy this defect.

ALUM.

The manufacture of alum from clay and clay slate, or shale, is now beginning to assume a considerable aspect in the list of our manufactures; and several improvements in this way have lately been patented which promise to extend largely this branch of industry. One in particular, for the fabrication of alum from the ash or residue left after the combustion of a kind of coal called Boghead coal, seems based on that sound principle of industrial economy which turns every waste product to profitable account. It was but the other day that this very Boghead ash was a serious impediment to the sale of the coal, and perceptibly diminished its price in the market. Now, however, it constitutes a decided item of value, and powerfully vindicates the right of chemistry to the title of a useful and profitable science. In preparing alum from clay or shale, it is of infinite importance that so much and no more heat be applied to the clay or shale, in the first instance, as will just expel the water of combination, without inducing contraction. A temperature of 600° Fahr. is well adapted to effect this object, provided it be maintained for a sufficient period. When this has been carefully done, the silicate of alumina remaining is easily enough acted upon by sulphuric acid, either slightly diluted or of the ordinary commercial strength. The best form of apparatus is a leaden boiler, divided into two parts by a perforated septum or partition, also in lead,—though, on a very large scale, brickwork, set in clay, might be employed. Into one of the compartments the roasted clay or shale should be put, and diluted sulphuric acid being added, the bottom of the other compartment may be exposed to the action of a well-regulated fire, or—what is better—heated by means of steam through the agency of a coil of leaden pipe. In this way, a circulation of the fluid takes place throughout the mass of shale; and, as the alumina dissolves, the dense fluid it produces, falling continually towards the bottom of the boiler, is replaced by dilute acid, which, becoming in its turn saturated, falls like the first; and so on in succession, until either the whole of the alumina is taken up, or the acid in great part neutralized. The solution of sulphate of alumina, thus obtained, is sometimes evaporated to dryness and sold under the name "concentrated alum;" but more generally it is boiled down until of the specific gravity of about 1·35; then one or other of the carbonates, muriates, or sulphates of potash or ammonia, or a mixture of these, is added to the boiling fluid; and as soon as the solution is complete, the whole is run out into a cooler to crystallize. The rough alum, thus made, is sometimes purified by a subsequent recrystallization; after which it is "rocked" for the market: a process intended merely to give it the ordinary commercial aspect, but of no real value in a chemical point of view. Alum not unfrequently contains iron,—an impurity which unfits it for many uses in the arts, and more especially for the purposes of the dyer. The best mode of ascertaining the presence of this impurity, and demonstrating its amount, is that previously stated in the commencement of this article:—That is, mix a solution of the suspected alum with tartaric acid, or an alkaline tartrate, and then add an excess of carbonate of soda; after which, pour in a few drops of hydrosulphate of ammonia, when, if iron be present, a black precipitate will ensue. If the alum contains lime or magnesia, then the addition of carbonate of soda causes a white precipitate, which must be removed by filtration before applying the hydrosulphate of ammonia.

SAND FOR GLASS MAKING.

Progressing onward in geological order, we pass at once from clay to sandstone,—from minerals containing alumina, to those consisting chiefly of silica. In no case do we trouble our readers by commenting upon the gems and precious stones belonging to these classes of minerals. Such things will occupy our attention with more propriety when speaking of artificial gems;—at present they are out of place in a manufacturing sense. The Great Exhibition is well furnished with specimens of the finer kinds of sand; some of which—as those from the Isle of Wight and the neighbourhood of Lynn—are remarkably white and beautiful. By far the finest sample of sand ever seen in this country is, however, in the American department of the Crystal Palace, and will not fail to attract the notice of those interested in such matters. This sand is contained in two or three barrels in the southern side of the building, and seems totally free from iron and every other source of contamination. It is positively as white as snow, and, so far as the making of glass is concerned, may rival or supersede the best flint—even if the high price of this latter article did not form an insuperable obstacle to its employment. It is from T. Gray & Co., Boston, Massachusetts; but its geological locality is not stated. The principal exhibitors of sand for the manufacture of glass are—Sir T. Maryon Wilson, of Charlton; J. Rock, jun., of Hastings; Whittaker & Winksworth, Derbyshire; J. Claxton, of Alum Bay, and J. Squire, of Yarmouth, Isle of Wight; S. Relf, of Reigate, and G. Morrison, of the same town, agent to Earl Somers; with J. Long, of Limerick; J. Deering, of Cork; T. Smedley, of Landidno; and J. Lee, of Hartwell, near Aylesbury. These specimens of sand have all more or less of the yellow topaz hue, indicating oxide of iron, and which imparts to all glass the green tinge so very perceptible in the common window variety. To remove this oxide of iron from sand has never yet, we believe, been attempted; though if we may judge by the trouble taken to nullify its influence in the manufacture of glass, an effectual process of the kind would be a lucrative discovery. When sand containing oxide of iron is mixed with a little charcoal, and subjected at a red heat to the action of chlorine gas, the whole of the iron is volatilised as chloride of iron, and the silica remains pure as soon as the excess of charcoal is burnt off: this experiment seems to suggest the possibility of purifying the glass-makers' sand by the employment of the waste muriatic acid now thrown away so largely by our soda makers. Even at ordinary temperatures, the solution of oxide of iron by this means might be hoped for; but there can be no practical objection to the use of a reasonable amount of heat for such a purpose, if found necessary.

The present article has already somewhat exceeded our limited space; and hence we are compelled to defer our remarks upon the manufacture of glass until our next number. This subject will, however, be there resumed, and the industrial associations of lime, magnesia, baryta, &c., investigated.

MUSICAL INSTRUMENTS.

THE ORGAN.

THE continental nations have, until very lately, been in advance of the English in regard to their large organs. It is true that, in the mere mechanical construction and workmanship, our builders have generally excelled; but the principles of design used here have been imperfect, and until the re-adoption, within the last few years, of the continental models, England can scarcely be said to have possessed a large organ worthy of comparison with the magnificent instruments of Germany, of Holland, or of France.

When we consider that so long ago as the end of the sixteenth century the organ had arrived, as regards all essential features of its design, at its present state of perfection, it seems strange that England—a country not usually backward in works of scientific construction—should have fallen so much behind the rest of Europe in this particular. We have no excuse in the nature of our forms of religious worship; for Holland and great part of Germany bear witness that Protestantism by no means tends to discourage the use or the improvement of the organ: we believe that the cause of the evil is to be found in the general indifference (peculiar to this country) manifested in regard to the musical portion of our religious services. It would be out of our province here to trace this historically; we must content ourselves with briefly noticing the principal points in which the plan of construction adopted in England, down to a late period, has differed from the foreign model, now rapidly taking its place. These are three, all of vital importance to the constitution of a large instrument.

In the first place, all the stops speaking below the unison or fundamental note have been omitted. We believe that twenty or thirty years ago there was not an organ in England that possessed a 16-feet stop on the manual clavier. This necessitated also a reduction of the compound and harmonic stops, and the consequence was that the instrument lost its weight of tone, and the most effective means of giving it power. But it brought a still worse evil, as regards the style of playing; indeed, in this, as in many other instances, the deterioration in the instrument itself, and in the manner of using it, have been intimately connected. A great but universal fault in English organ performers has been the abandonment of the original method of playing in *distinct parts* (so beautifully exemplified by the German organ writers and players), and the substitution of a vicious manner of putting down as many notes as possible by full chords in each hand, to the utter destruction of clearness in the composition, and the total loss of what has always been one of the distinguishing features of good organ music, viz., *counterpoint*. That full chords may occasionally be employed for certain effects, is shewn by many of the works of Bach and other great organ composers; but this method of playing, as a system, is exceedingly objectionable, and has, we believe, done much to check the cultivation of the higher style of musical composition. Yet the full style of playing becomes almost indispensable on the English organ. The absence of the 16-feet stops makes playing in parts sound thin and meagre, and the organist is thus obliged to provide against the defects of his instrument, by introducing compensating defects in his performance. On the other hand, the better construction of organ does not admit of the bad style of playing; for, if full chords are persevered in where 16-feet stops exist, the effect becomes confused and disagreeable.

Secondly. The pedal organ has been almost entirely abandoned. Until very lately, in the vast majority of cases, even no pedal clavier has existed;* and where a few keys have been added, they have seldom done anything more than pull down the bass notes of the manual clavier. One stop of eight or a dozen "pedal pipes" has been considered a bold improvement. Hence, another great defect in English organ playing has been the absolute ignorance of the use of the pedals. In the few cases where organs had these appendages, the organists either carefully avoided them, or used them only now and then to hold a "pedal point;" occasionally, perhaps, some bold player would employ them to double the bass notes in easy passages, but the idea of their playing a separate part of the composition, entirely distinct from the hands, does not seem to have entered into the mind of any one. Whether the abandonment of the pedal organ was the cause of the disuse of pedal playing, or *vice versâ*, we have now no means of knowing. Probably they both went on together. The absence of the pedal organ, combined with the want of 16-feet stops, has led to the extension of the manuals downwards below the orthodox C. In the first place, the key C sharp was made to speak A, and another key, B, was added, speaking G; this ridiculous arrangement was called the "short octave;" but the compass was subsequently extended to G entirely, and called the "long octave." This was the usual extent of English organs until the re-adoption of the foreign plan.

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* A curious tradition is extant of an organist of the last century, who produced what was considered by his hearers an almost magical effect, by placing a piece of lead on a bass note to form a "pedal point."

Thirdly. The English organs have had little or no variety in the quality of tone of their stops. Only one or two solo stops have been known; and these have been but little used.

It is a remarkable proof of the deterioration of the organ in the last century, that Handel, who was Bach's contemporary, but whose career, as a composer, was entirely English, wrote no organ music, properly so called. All his clavier compositions do equally well for the harpsichord or the pianoforte. We know of no evidence that he either wrote for or used the pedal clavier.

Happily, however, the time has now arrived when both organ-builders and organ-players, in England, are beginning to follow the more perfect methods of their continental neighbours. The origin of the improvement may, we believe, be traced to the introduction to the English public, some quarter of a century ago, of the immortal organ works of John Sebastian Bach. It was soon perceived from them, that not only were our players ignorant of the true organ style, but that the true organ music could not be played upon our organs. This led to the examination of foreign instruments, and to a gradual adoption of their principles of construction; which may now be said to be fast becoming general. The result is a marvellous improvement in organ-playing; for whereas the compositions alluded to were sealed books to the organists of the last generation, they now form the ordinary practice of every accomplished organ performer.

The following table exhibits a comparative view of the contents and composition of several of the largest organs in the world:—

COMPARATIVE TABLE OF THE COMPOSITION OF SEVERAL LARGE ORGANS.

			FRANCE.			GERMANY AND HOLLAND.				ENGLAND. *(Old Plan.)*			ENGLAND. *(Modern Plan.)*			
			St. Denis.	Madeleine.	St. Sulpice.	St. Michael's, Hamburg.	St. Paul, Frankfort.	Weingarten, Suabia.	Haarlem.	York Minster.	St. Paul's Cathedral.	Canterbury Cathedral.	Birmingham Town Hall.	Ashton-under-Lyne.	St. Peter Radley, Oxford.	Willis. (Exhibition.)
GREAT ORGAN.			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Flute Stops	Dble. dble.	32 feet	1	3	1	...	1	...	...	...	...	...	...	...	...	...
	Double	16 „	3	7	3	2	3	2	2	...	...	...	1	1	1	2
	Unison	8 „	6	...	5	4	3	7	3	6	3	3	4	3	3	3
	Fifth	5⅓ „	...	2	...	1	1	...	1	...	...	...	1	1	1	...
	Octave	4 „	3	...	1	2	2	4	2	10	1	1	2	2	2	3
	Tenth	3⅕ „	...	1	...	...	1	...	...	...	...	...	...	1	1	...
	Twelfth	2⅔ „	2	2	1	1	1	1	1	2	1	1	1	1	1	1
	Fifteenth	2 „	2	10	1	1	1	1	1	6	2	1	2	1	2	3
	Others	....	27	1	26	19	18	45	12	36	8	7	14	7	7	10
Reed Stops	Double	16 „	1	4	1	1	1	...	1	...	...	...	1	1	1	1
	Unison	8 „	5	1	4	1	2	1	2	5	2	2	1	1	1	1
	Octave	4 „	3	...	3	...	1	...	1	3	1	1	1	1	1	1
	Fifteenth	2 „	...	...	...	...	...	...	...	...	...	...	1	1	...	1
CHOIR or POSITIF.																
	Double	16 feet	1	...	1	1	1	0	1	...	...	...	...	...	...	1
	Unison	8 „	6	6	9	5	7	5	5	5	5	3	4	4	4	6
	Octave	4 „	4	3	3	2	3	4	2	3	1	3	4	3	2	5
	Others	....	11	1	16	13	8	17	16	10	2	...	1	1	1	2
SWELL or UPPER CLAVIER.																
Flute Stops	Double	16 feet	...	...	1	1	1	1	1	...	...	1	1	1	1	2
	Unison	8 „	3	3	3	3	4	4	3	5	2	2	2	3	3	5
	Octave	4 „	2	...	1	2	4	1	2	4	1	1	1	2	2	3
	Fifteenth	2 „	...	1	...	...	1	2	1	1	1	1	1	2	1	2
	Others	....	2	...	5	15	1	16	14	11	2	4	3	11	8	13
Reed Stops	Unison	8 „	2	4	3	2	3	1	3	4	3	3	4	3	2	4
	Octave	4 „	1	...	...	...	...	...	...	...	...	...	1	1	...	1
Total pipes to each note ...			85	49	88	76	68	112	74	111	35	34	51	52	45	70
PEDAL ORGAN.																
Flute Stops	32 feet	....	...	1	1	2	2	2	1	3	...	...	2	...	...	1
	16 „	....	3	2	2	3	5	3	2	3	1	2	4	2	2	4
	8 „	....	1	2	2	1	4	4	2	...	...	...	1	1	1	2
	4 „	....	1	...	1	1	2	2	1	...	...	...	1	1	1	1
	Others	....	1	...	...	12	5	18	5	...	...	...	9	6	6	7
Reed Stops	32 feet	....	...	...	1	1	...	1	1	1	...	...	1	...	...	...
	16 „	....	1	1	2	1	2	1	1	1	...	...	1	1	1	1
	8 „	....	3	1	2	1	1	1	1	...	...	...	1	...	1	1
	4 „	....	2	1	1	1	1	...	1	...	...	...	1	...	...	1
Total pipes to each pedal ...			12	8	12	23	22	32	15	8	1	2	21	11	12	18
Total pipes in the organ ...			4506	...	...	...	...	6666	5000	8000	...	...	4000	...	2833	4500

REMARKS.

(1) Built by M. Cavaillé, in 1841.

(2) Built by the same maker, in 1846. These two organs contain several stops entirely new, and unknown in this country.

(3) Altered and enlarged by Mr. Barker, in 1846. The cost of this organ, from first to last, has been 146,450 francs, or nearly £6000.

(4) Built by Hildebrand, in 1762, at a cost of £4000.

(5) Built by Walcker, of Louisbourg, in 1833, at a cost of 30,000 florins, or about £2500.

(6) Built by Gabler, of Ravensburg, in 1750. This organ is peculiar in having so many compound stops and so few reeds.

(7) Built by Christian Muller, in 1738. This organ is much more landed than it deserves to be. It is a tolerably large organ, on the German plan, of average quality; nothing more.

(8) Built by Elliot & Hill, of London, at a cost of £5000. It is of immense size, but unfortunately is laid out on an imperfect plan, which renders it a much less effective instrument than many of half its pretensions. It will be noticed that there is not a single 16-feet stop on any of the manual claviers.

(9) Built by Schmidt, in 1697, and lately enlarged by Bishop.

(10) An old organ, enlarged by Hill. This and the two former are inserted here to shew the peculiarities of the old English plan of building large organs.

(11) This organ was built by Hill, in 1834; but, in defiance of his remonstrances, was laid out in such an absurdly erroneous manner, that it proved a total failure. It was afterwards entirely re-modelled.

(12) Built by Hill.

(13) Built by Messrs. Telford, of Dublin.

(14) More fully described in the present article.

The Industrial Exhibition of 1851 contains fourteen organs, eleven English, one from France, one from Germany, and one from Florence. Of these, three English, one French, and one German, are large organs, of a scale suitable to a church or other large building; the others are small or chamber organs.

Messrs. Hill & Co. exhibit a small but effective organ, of 16 stops, and containing several novelties. It has two rows of keys, and the contents are as follows:—

Great Organ (lower clavier).

1.	Double diapason	Open 16 feet.
2.	Open diapason	Open 8 feet.
3.	Stopped diapason	Stopped 8 feet.
4.	Octave	Open 4 feet.
5.	Twelfth	Open 2⅔ feet.
6.	Fifteenth	Open 2 feet
7.	Sesquialter	Compound 3 ranks.
8.	Cornopean	Reed 8 feet.
9.	Krum-horn	Solo reed 8 feet.
10.	Wald-flute	Open wood 4 feet.

Swell Organ (upper clavier).

1.	Claribel	Open wood 8 feet.
2.	Gems-horn	Open 8 feet.
3.	Hohl-flute	Open 8 feet.
4.	Hautboy	Soft reed 8 feet.
5.	Tuba mirabilis	Loud reed 8 feet.

Pedal Clavier.

1.	Double diapason	Open wood 16 feet.

The compass of both the manual claviers is 4¼ octaves, from C to F; that of the pedals is 2¼ octaves, from C to E.

The stop called *cornopean,* in the great organ, is a reed giving a round full tone; the *krum-horn* has a cylindrical pipe, and the tone is of a thinner and softer quality; the *wald-flute* is an open wood solo stop, voiced in a peculiar manner.

In the swell, the *claribel* is an open wood stop, now often substituted in the treble for the stopped diapason, as giving a better quality of tone, and being more useful for solo playing. The *gems-horn* is an open metal pipe, with a tube tapering upwards above the mouth in the form of a frustrum of a cone: this stop is taken from the Germans. The *hohl-flute** is an open metal pipe, giving a clear reedy tone.

The *tuba mirabilis* is a new kind of reed stop, invented by Mr. Hill, and first introduced by him into the organ in the Town Hall, Birmingham. It is on a large scale, and blown by a very high pressure of wind, equal to that of a column of water about 11 inches high. It gives a fine round tone, and is of itself nearly equal in power to all the rest of the organ put together.

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* Such terms as "claribel," "wald-flute," "hohl-flute," &c., are hybrid words, half taken from one language and half from another. "Krum-horn" (crooked horn), "gems-horn" (chamois-horn), and "tuba mirabilis," convey no meaning descriptive of the stops they are applied to. This absurd polyglot system of nomenclature is altogether unnecessary, and therefore objectionable.

There are four composition pedals to change the stops in the great organ;—the first brings on Nos. 1, 2, and 3; the second, Nos. 1, 2, 3, 4, and 6; the third, Nos. 1 to 7; and the fourth the full organ. There are also couplers to unite the two claviers, and to cause the pedal-keys to act on either the great organ or the swell.

The stops are not worked by draw-stops, on the customary plan, but by keys, something like those of the manual claviers, placed on each side, within reach of the performer's hands. One row of these keys serves to open the several stops, and another to shut them. As, however, the mere pushing down of a key with the finger would not, of itself, give power or motion enough to move the slider,—the aid of an intermediate apparatus, on the principle of the "pneumatic lever" (see description of the French organ), is called in. The pressing down of the key admits, by a small valve, compressed air into a bellows, the motion of which is communicated to the slider.

In the bass half of the instrument, Mr. Hill has adopted a new kind of valve or pallet, with the object of lightening the touch. It is on the principle of what is called the *double-beat* valve, used in steam-engines.* The valve hangs vertically, and shuts upon two vertical faces; and it is only the pressure of wind acting on the surface contained between these two faces, which has to be overcome in opening the valve.

Another novelty in this organ is the arrangement of the trunks or passages conveying the compressed air from the bellows to the wind-chests of the sound-boards. These are, in large organs, of considerable size, and, as usually placed, come very inconveniently in the way of the various movements and machinery connected with the keys, stops, composition pedals, &c. Mr. Hill dispenses with them altogether, by making the framing and main standards which support the sound-board, *hollow*, and using them as wind passages. This ingenious contrivance leaves the space under the sound-boards completely free and open, and gives increased facilities for the beneficial arrangement of the action.

There are two bellows, one for the ordinary pressure, and one for the highly compressed air required for the "tuba mirabilis." They are both worked by the same handle, and are so connected that any escape, by over-blowing the high-pressure bellows, is not lost, but passes into that of the lower pressure.

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* See "Pole on the Cornish Engine." Arts. 112 to 115.—Weale, London, 1844.

The whole of the pipes are enclosed in a box, having moveable Venetian shutters in front; so that the entire organ forms one large swell: within this is also contained another box, with a similar Venetian front, enclosing the organ of the upper clavier: this latter, therefore, forms a swell within a swell, and its sound, when both are shut, is very subdued.

Each of the two pedals working the two sets of shutters is furnished with a rack and self-acting catch, which cause it to remain stationary at any point it is set to by the player; by placing, however, the foot on a particular part of the pedal, the catch is thrown out of gear, and the pedal follows the foot up or down, in the ordinary way.

This organ has no case,—the whole of the machinery being exposed to view. The wind-chest is provided with a glass front, by which the peculiar construction of the valves may be seen.

Messrs. Gray and Davison exhibit three organs, viz., a large church organ, placed in the gallery at the extreme eastern end of the building; an improved barrel organ, and a small church organ in the north gallery of the transept.

The large church organ has three rows of keys, and 34 stops, viz.,—

Great Organ (middle clavier).

1.	Double open diapason	Open 16 feet.
2.	Open diapason	Open 8 feet.
3.	Open diapason	Open 8 feet.
4.	Stopped diapason	Stopped 8 feet.
5.	Octave	Open 4 feet.
6.	Flute	Stopped wood 4 feet.
7.	Twelfth	Open 2⅔ feet.
8.	Fifteenth	Open 2 feet.
9.	Flageolet	Open wood 2 feet.
10.	Sesquialter	Compound 3 ranks.
11.	Mixture	Ditto 2 ranks.
12.	Posaune	Reed 8 feet.
13.	Clarion	Reed 4 feet.

Choir Organ (lower clavier).

1.	Dulciana	Open 8 feet.
2.	Keraulophon	Open 8 feet.
3.	Stopped diapason bass	Stopped 8 feet.
4.	Clarionet flute	Half stopped wood 8 feet.
5.	Octave	Open 4 feet.
6.	Flute	Open wood 4 feet.
7.	Fifteenth	Open 2 feet.
8.	Clarionet	Reed 8 feet.

Swell Organ (upper clavier).

1.	Bourdon	Stopped 16 feet.
2.	Open diapason	Open 8 feet.
3.	Stopped diapason	Stopped 8 feet.
4.	Octave	Open 4 feet.
5.	Fifteenth	Open 2 feet.
6.	Sesquialter	Compound 3 ranks.
7.	Cornopean	Reed 8 feet.
8.	Oboe	Reed 8 feet.
9.	Clarion	Reed 4 feet.

Pedal Organ.

1.	Grand Open diapason	Open wood 16 feet.
2.	Grand Bourdon	Stopped 16 feet.
3.	Grand Octave	Open 8 feet.
4.	Grand Bombarde	Reed 16 feet.

The compass of the great and choir organs is from C to F, four and a half octaves; the swell organ is an octave less, extending only down to tenor or 4-feet C. The clavier has, however, the same compass as the other two, the notes below 4-feet C playing on the choir organ. The compass of the pedals is two octaves and a third, from C to E.

The stop called *keraulophon*[*] is the invention of this firm, and was first introduced by them in the organ at St. Paul's Church, Wilton-place. It consists of an open metal pipe, having a sliding tube at the top, pierced with a hole in the side. It gives a very agreeable tone, intermediate in character between a flute stop and a horn or soft reed.

There are five coupling stops. The first couples the swell upon the great organ manual, and the second upon the choir. A third causes the pedals to pull down the lower keys of the great organ, and a fourth answers the same purpose for those of the choir. The fifth coupler brings the pedals on the swell an octave higher; the lowest note acting on 4-feet C, and the upper one extending high into the treble part of the clavier; by which means a *canto firmo* may be played by the pedals in the tenor part, or even in the soprano, if required.[†] There is another coupling apparatus, in the form of a pedal, which brings the great organ upon the swell; this is called the *sforzando* pedal, its use being to give a sudden *forte* while playing on the swell organ.

There are six composition pedals for changing the stops. The first two belong to the swell,—one bringing on the two

[*] From *κερας*, a horn, *αυλος*, a flute, and *φωνη*, sound;—an ingenious and appropriate name, albeit rather pedantic. "Horn-flute" would have answered the purpose, with the advantage of being intelligible to the multitude.

[†] *Vide* several such arrangements in the *Choral Vorspiele* of Sebastian Bach.

stops marked 3 and 7; the second the full swell organ. The other four pedals belong to the great organ; the third gives stops Nos. 2, 4, 6, and 9; the fourth Nos. 1, 2, 3, and 4; the fifth brings on a *forte* combination, consisting of Nos. 1, 2, 3, 4, 5, 7, 8, and 10; and the sixth gives the *fortissimo* or full organ.

The swell box has a double set of Venetian louvre boards, one in front of the other, the more effectually to shut in the sound. They are both acted on by the same pedal.

The bellows are of the double construction, and placed outside the organ case. They are two in number, giving different pressures of wind; the higher pressure applies to the pedal organ, the lower one to the remainder of the instrument.

The barrel organ exhibited by Messrs. Gray and Davison is on a new principle, patented by them. As the general construction of a barrel organ may be assumed to be known to our readers, it will merely be necessary to explain how the present apparatus differs from the ordinary plan. Its object is to avoid the trouble of changing the barrels. Only a very limited number of tunes, say about 10 or 12, can be set on one barrel; and, according to the usual arrangement, whenever others than these are wanted, the barrel has to be taken out, and another substituted;—a work requiring much time and trouble, as well as, if the barrels are large and heavy, no inconsiderable amount of exertion. To avoid this, the patentees hang the centres of all the barrels on the circumference of a centre wheel, by simply turning which any barrel can be brought under the keys, into the proper position for playing. On the axle of the wheel is a screw, working into a fixed nut; so that when the wheel is made to revolve, it acquires thereby also a lateral motion, which answers the purpose of the lateral shifting of the ordinary barrels in changing the tune. For example, supposing any given barrel to be placed opposite the keys, and the centre wheel then turned through a whole revolution, so as to bring that barrel to the same place again, the whole apparatus will, during such revolution, have moved laterally through the distance necessary to bring another tune on that barrel into gear; and so on for all the others. It follows from this that a certain lateral position of the apparatus always corresponds to a certain tune, and the name of the tune in gear at any time is shewn on the outside of the case by a sliding index, worked by a rack and pinion from the axle of the wheel. By this improvement the organ can be set for any tune, on any barrel, with more accuracy and facility than can be obtained by the ordinary plan on one barrel only.

The present instrument is a small one, containing thirty psalm tunes on three barrels, and has three stops. The tunes are arranged in four distinct parts, so that the organ may be used to lead a choir of voices if required.

This organ is not enclosed in a case, but the whole of the machinery is exhibited to view. The framework is so constructed that there is no necessity to take the instrument to pieces for removal or exportation.

The same firm also exhibit a small church organ, with one row of keys, and a pedal clavier. There are eight stops to the manuals, and one (16 feet) to the pedals. It has also couplers and composition pedals, and the whole is enclosed in a case, having Venetian swell shutters in front.

Mr. Willis exhibits a large organ of three claviers and 70 stops, erected in the gallery at the western end of the building. Its contents are as follows:—

Great Organ (middle clavier).

1.	Double diapason	Open 16 feet.
2.	Bourdon	Stopped 16 feet.
3.	Open diapason	Open 8 feet.
4.	Open diapason	Open 8 feet.
5.	Stopped diapason	Stopped 8 feet.
6.	Principal	Open 4 feet.
7.	Principal	Open 4 feet.
8.	Wood-flute	Open wood 4 feet.
9.	Twelfth	Open 2⅔ feet.
10.	Fifteenth	Open 2 feet.
11.	Fifteenth	Open 2 feet.
12.	Piccolo	Open wood 2 feet.
13.	Doublette	Open 1 foot.
14.	Sesquialter	Compound 3 ranks.
15.	Fourniture	Ditto 3 ranks.
16.	Mixture	Ditto 3 ranks.
17.	Trumpet	Reed 16 feet.
18.	Trumpet	Reed 8 feet.
19.	Clarion	Reed 4 feet.
20.	Octave clarion	Reed 2 feet.

Choir Organ (lower clavier).

1.	Bourdon	Stopped 16 feet.
2.	Open diapason	Open 8 feet.
3.	Dulceana	Open 8 feet.
4.	Viol di gamba	Open 8 feet.
5.	Stopped diapason	Stopped 8 feet.
6.	Viola	Open 4 feet.
7.	Flute,—metal	Stopped metal 4 feet.
8.	Flute,—wood	Open wood 4 feet.
9.	Principal	Open 4 feet.
10.	Piccolo	Open wood 2 feet.
11.	Fifteenth	Open 2 feet.
12.	Corno di bassetto	Reed 8 feet.
13.	Cremona	Reed 4 feet.
14.	Oboe,—orchestral	Reed 8 feet.

Swell Organ (upper clavier).

1.	Double diapason	Open 16 feet.
2.	Double dulceana	Open 16 feet.
3.	Open diapason	Open 8 feet.
4.	Open diapason	Open 8 feet.
5.	Dulceana	Open 8 feet.
6.	Viol di gamba	Open 8 feet.
7.	Stopped diapason	Stopped 8 feet.
8.	Flute	Open wood 8 feet.
9.	Principal	Open 4 feet.
10.	Principal (soft quality)	Open 4 feet.
11.	Twelfth	Open 2⅔ feet.
12.	Fifteenth	Open 2 feet.
13.	Fifteenth (soft quality)	Open 2 feet.
14.	Dulcimer (soft quality)	Compound 3 ranks.
15.	Sesquialter	Ditto 3 ranks.
16.	Fourniture	Ditto 3 ranks.
17.	Mixture	Ditto 3 ranks.
18.	Trombone	Reed 8 feet.
19.	Trumpet	Reed 8 feet.
20.	Clarion	Reed 4 feet.
21.	Hautboy	Reed 8 feet.
22.	Cremona	Reed 8 feet.

Pedal Organ.

1.	Double-double diapason	Open wood 32 feet.
2.	Double diapason	Open wood 16 feet.
3.	Double diapason	Open metal 16 feet.
4.	Violon (soft quality)	Open metal 16 feet.
5.	Bourdon	Stopped 16 feet.
6.	Octave,—wood	Open wood 8 feet.
7.	Octave,—metal	Open metal 8 feet.
8.	Quint	Open 5⅓ feet.
9.	Super octave	Open 4 feet.
10.	Sesquialter	Compound 3 ranks.
11.	Mixture	Ditto 3 ranks.
12.	Tromba	Reed 16 feet.
13.	Trombone	Reed 8 feet.
14.	Clarion	Reed 4 feet.

The compass of all the three manual organs is the same, viz., 4½ octaves, from C up to G. The compass of the pedals is 2½ octaves, from C to G.

The stops in the great organ require no comment, further than to explain that whenever two stops of the same name occur, as 3 and 4; 6 and 7; 10 and 11; they are voiced to different qualities of tone.

The choir organ contains principally solo stops. The *viol di gamba* is an open metal pipe of a small scale, tapering upwards, and terminating in an inverted cone; it produces a thin quality of tone. The *viola* is of the same quality, but speaks an octave higher. The *metal flute*, No. 7, is a *flute-a-cheminée*. The *corno di basetto* is a reed-stop, with a tone like a clarionet. The *cremona* is similar, but speaks an octave higher. The *orchestral oboe* is peculiarly voiced to imitate the instrument whose name it bears.

The swell organ is unusually large. The box containing it is 12 feet square, and 14 feet high. The stops marked Nos. 2, 5, 10, 13, and 14, taken together, form a complete full organ, of a "dulceana" or soft quality throughout; the effect of which, when the swell is shut, is very remarkable, resembling a band at a distance. By the new stop movement (hereafter explained), it can be alternated with the full swell with great facility, by which striking and novel effects may be obtained.

The Venetian shutters of the swell-box are made to fit very closely, by which the sound is much subdued. It is often found in large organs that there is a difficulty in doing this, in consequence of the necessity of providing apertures for the escape of the large quantity of wind passing through the pipes; and it has been remarked that, if sufficient opening be not left for this purpose, the pipes will be sluggish in speaking, or will sound out of tune. Mr. Willis has overcome this difficulty in an ingenious manner, by placing within the swell-box, a separate bellows, used to supply the swell organ. By this contrivance the wind, instead of escaping out of the box, circulates continually within it, and thus the box may be made perfectly tight without inconvenience.

Both the great and swell organs have the pneumatic lever (hereafter described in the French organ) applied to the keys, by which the touch is rendered light and agreeable. Mr. Willis has introduced, however, modifications in its application; he dispenses with the higher pressure of wind, using only such as is given by the bellows for supplying the organ in general, and adopts an improved valve for the more instantaneous exhaustion of the air.

There are four different pressures of wind used in this organ,—one for the flute-stops in the swell, a higher pressure for the pedals, a higher still for the great and choir organs, and the highest for the swell reeds. Each of these different pressures is given by a separate bellows, and four men are required to blow when the full organ is used.

There are seven couplers, namely,—to bring the swell or the choir on the great organ; the great or the choir on the swell; and the pedals on either of the three manual claviers.

The principal novelty in this organ is a contrivance for acting on the draw-stops, intended to supersede the composition pedals. On the key slip, which is of brass, immediately below each clavier, project a number of small studs, each of which corresponds to, and is labelled with, a certain combination of stops belonging to the clavier adjoining; when the hands are upon the keys, these studs, lying directly below, can be touched easily with the thumbs, and when any one of them is slightly pushed in, in this manner, it draws the combination of stops to which it corresponds, in the same manner as the composition pedals. This is effected by the aid of a pneumatic apparatus, on the same principle as that applied to the keys. The stud, on being touched, admits compressed air into a bellows, which immediately rises with sufficient power to act, by means of rods and levers, on the machinery of the stops, drawing out those which the given combination requires, and pushing in those that are superfluous. In most cases there is a duplicate stud for each combination, so that it may be obtained by using either the right or left-hand.

The valve used to admit the wind to the pipes in the pedal organ is of a new construction. It is formed by covering the aperture with a piece of leather or other flexible substance, fixed at one end, and attached at the other end to a wooden roller. When this roller is moved, by a wire attached to the pedal key, it wraps the leather round it, and so uncovers the opening; when the key is let go, a spring brings the roller back, and, by unrolling the leather, covers the aperture again.

The valve used for the choir organ is also of a new construction, designed with the object of reducing the force necessary to open it. It may be described as an ordinary valve or pallet, having fixed in the middle of it, on the under side, a small bellows, of the single kind: the upper board of this is formed by the valve itself,—the lower one is *fixed* by a screw. The effect of this is, that the pressure of the wind upon the valve is not exerted over its whole area, but is only what is due to the difference between the area of the valve and that of the lower board of the small bellows. By this means a large opening may be obtained with a light pressure.

The novelties above described, namely, the placing the bellows inside the swell-box; the arrangement for drawing the stops; the pedal valve; and the choir organ-valve; as well as some improvements in the pneumatic apparatus, and in the construction of the mechanical details of the organ, are protected by a patent dated 28th February, 1851.*

The dimensions of the organ are about 25 feet wide, 23 feet deep, and 30 feet high: it stands upon 575 superficial feet area, and its solid contents are 17,250 cubic feet. It contains about 4500 pipes. Its composition, as exhibited in column 14 of the table, at page 191, will shew that it is worthy of being compared with some of the largest organs in the world.

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* We may probably give a more detailed description of Mr. Willis's patented improvements in a future number of this Journal.

Mr. Bishop exhibits a small cabinet organ, with one row of keys and an octave of pedals, and five stops. It contains the two inventions of this builder, described on page 115, namely, the composition pedals (in this organ five in number) and the anti-concussion apparatus for steadying the wind.

Mr. Walker exhibits a small organ, in a highly-ornamented gothic oak case; it has one row of keys, 2¼ octaves of pedals, and nine stops, including pedal-pipes. There are four composition pedals for changing the stops, and a coupler to throw the pedals on or off the manual clavier at pleasure.

Mr. G. M. Holdich exhibits an organ of three stops, with a coupler to cause each key to take down the octave above (see page 115, and also the description of the French organ); this the builder calls a "diaocton."

Mr. H. Bryceson exhibits a barrel organ of six stops, with three barrels, each playing 12 tunes.

Mr. T. F. Room, a manufacturer of metal organ-pipes, exhibits a set of specimens of various flute and reed-stops, made in two different kinds of metal.

Mr. Dawson exhibits a mechanical organ on a new construction, which he calls an *autophon,* and for which he has a patent. This instrument has no wind-chest, valves, or keys, but the wind is conveyed directly from the bellows to the channels of the sound-board by a row of passages, which are cut through transversely by a long horizontal slit, just large enough to admit a sheet of pasteboard. This pasteboard is pierced with a number of holes, corresponding to the given tune to be played, and is drawn through the slit by rollers, turned by a winch; when, therefore, the holes come opposite the passages in succession they admit the wind to the sound-board, and cause the corresponding notes to play. This instrument might be called a *jacquard* organ. It is simple, and does away with barrels, and many other expensive parts; but it has the disadvantage of admitting the wind gradually into the pipes, and cutting it off gradually from them; the effect of which is a disagreeable wavering at the commencement and termination of the note.

A curious instrument is exhibited in the north gallery, called the *enharmonic organ.* It is built by Messrs. Robson, to the design of Col. T. Perronet Thompson, M. P., and its object is to get rid of what is called *temperament,* and to give the power of playing strictly in tune, which (as is well known to those who have studied the theory of harmonics) cannot be done according to the ordinary duodecimal division of the octave. Attempts have often been made to diminish this evil, but the present one is more comprehensive than any that have preceded it. The instrument contains *forty-two* different sounds in the octave, distributed on three claviers, and music may be executed on it in a great variety of keys, perfectly in tune in all. The lower clavier corresponds to the key of C, and the notes E-flat, E, F, F-sharp, G, A-flat, and A, are tuned to form correct intervals with the key-note. The other notes, namely the major and minor second, and the major and minor seventh, require each to be *double*, to form perfect consonances with the other notes of the scale; for example, the same D which makes a correct fifth to G, will not form a correct fourth to A, but will be a "comma" too sharp, and so on for the rest. There are therefore two finger keys to each of these notes, conveniently placed so that either of them can be played at pleasure. The finger keys of the clavier are not coloured in the ordinary way, but the white and black are so distributed that those of similar colour will make concords in tune with each other. The second clavier is formed upon the key of E, and the upper one on that of D; and each clavier has a few extra notes in addition to those already mentioned, by the aid of which the three claviers together give a range of about twenty keys, in any of which music may be played without any imperfect or "tempered" intervals being used. The organ is tuned by a "Phonometer or monochord," acted on by weight, and has an ingenious method of correction for changes of temperature.*

In the western division of the nave stands an organ, in a gothic oak case, exhibited by M. Ducroquet, of Paris. It has two rows of keys, and twenty stops, as follows:—

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* A more detailed description of this instrument is contained in a pamphlet by Col. Thompson, published by Effingham Wilson, Royal Exchange. It gives much valuable matter on the subject of intonation, and the author exposes, with much force and vivacity, the absurdity of the common practice of blaming nature for the defects of the ordinary artificial musical scale. The well-known complaint, that a succession of twelve perfect fifths do not exactly correspond with seven octaves (a so-called anomaly, which has seriously been ascribed to a mysterious exercise of Divine power!) proves, when investigated, to be merely a statement of a mathematical truism, namely, that $\left(\frac{2}{3}\right)^{12}$ is not $= \left(\frac{1}{2}\right)^{7}$;—to complain of which, says Col. Thompson, is just as reasonable as to complain that twice three is not five! The only tenable defence of our usual duodecimal scale is, that it combines comprehensiveness with simplicity, and with only a small amount of error.

We are informed that the subject of just intonation on keyed instruments is at present exciting much attention in America.

Grand Orgue (lower clavier).

1.	Bourdon	Stopped 16 feet.
2.	Bourdon	Stopped 8 feet.
3.	Montre	Open 8 feet.
4.	Flute	Open 8 feet.
5.	Salicional	Open 8 feet.
6.	Prestant	Open 4 feet.
7.	Plein jeu	Compound 5 ranks.
8.	Bombarde	Reed 16 feet.
9.	Trompette	Reed 8 feet.
10.	Clairon	Reed 4 feet.

Récit, or Swell (upper clavier).

1.	Bourdon	Stopped 8 feet.
2.	Flute harmonique	Open 8 feet.
3.	Viola di gamba	Open 8 feet.
4.	Flute	Open 8 feet.
5.	Prestant	Open 4 feet.
6.	Trompette	Reed 8 feet.
7.	Hautbois et basson	Reed 8 feet.
8.	Cor Anglais	Free reed 8 feet.

Pedal Clavier.

1.	Flute	Open wood 16 feet.
2.	Bombarde	Reed 16 feet.

The compass of the two manual claviers is from C to C, five octaves; that of the pedals from C to C, two octaves.

In the great organ the following stops require special mention. The *bourdons* are stopped pipes,—the lower part of wood, with a solid plug, but the upper part of metal, with a tube through the stopper; these pipes being in fact *flutes à cheminée*. The *montre* is of tin, and, as its name implies, is the stop to which the front pipes of the case belong. The 8-feet *flute* is a pipe of new form, with a bell-shaped top, and called *flute-à-pavillon*; the tone is peculiarly full and clear. The *salicional* is an open metal pipe of a small scale, resembling what in English organs is called the "dulceana." The *plein-jeu* comprehends the twelfth, fifteenth, and three ranks above, repetitions of the fifth and octave: the French compound stops rarely contain the interval of the third.

The *récit* or swell, to which the upper clavier belongs, is enclosed in a box, with Venetian shutters in front. It contains several novel and remarkable solo stops. The *flute harmonique* is composed of pipes double the usual length, which overblow, and sound their octave above; it is powerful, and gives, when used as a solo, a very effective imitation of an orchestral flute. The *viola di gamba* is an open metal stop, of a very small scale, much smaller than the salicional; it produces a thin reedy tone, approaching that of stringed instruments, particularly in its lower notes, which may be compared with those of the violoncello. This resemblance is rendered the more striking, as each note is preceded by a harmonic sound, which recalls the effect of the bow in attacking the string.' The *hautbois* and *basson* form one stop,—the former belonging to the treble, the latter to the bass; they are reed-stops, constructed and voiced in a peculiar manner. The *cor Anglais* is a reed-stop, but on a different principle to the ordinary kind,—the reed being *free* and not beating against a fixed surface; it gives an excellent imitation of the instrument whose name it bears, or the *corno di bassetto*. The free-reed stops have been lately extensively introduced into organs by the French, but are not used by English builders.

The reed-stops in this organ are more numerous than is usual in instruments of this size. The reed of 16 feet on the keys is very rarely found in English organs. All the reed-stops in the great organ are placed upon a separate wind-chest, and are supplied with wind at a higher pressure than is used for the flute-stops. They are very powerful and effective, and give to the full organ that brilliant effect peculiar to French instruments.

There are seven mechanical pedals. The first causes the keys of the pedal clavier to act on those of the great organ. The second gives the power of throwing the great organ action on or off the great organ keys; so that (supposing the swell coupled upon this manual by pedal No. 3) a sudden *forte* or *piano*, of great effect, may be obtained. The third pedal couples the swell to the great clavier in unisons; the fourth couples it an octave above; and the fifth an octave below. The effect of these is extraordinary; an 8-feet stop may be converted into a 16-feet or a 4-feet, at pleasure; and a great variety of effects and combinations may be produced, which otherwise would be unattainable without increasing almost indefinitely the size of the organ. The sixth pedal brings the reed-stops upon the great organ; and the seventh opens the Venetian shutters of the swell-box.

The most important feature of this organ, however, is the *pneumatic lever*, applied here by its inventor, Mr. Barker. Its object is to lighten the touch. We have already stated, that in large organs the force necessary to open the valves becomes a great inconvenience, and many contrivances have been devised, tending to diminish the evil in a greater or less degree; but the pneumatic apparatus must be allowed to be the most complete and effectual of any, inasmuch as it gets over the difficulty at once, by rendering the resistance of the keys altogether independent of the work they have to perform. Mr. Barker, after having tried and rejected valve-modifications designed with this end, and being convinced of the inexpediency of restricting the size of the openings or the pressure of wind employed, conceived the bold idea of overcoming the heavy resistances by means of an *auxiliary power*, which the keys of the instrument should merely have to put in action and to control. This power was compressed air. In his first attempts he adapted to each note of the instrument a piston, working in a small cylinder, and the rod of which communicated with the machinery to be moved. The key opened a small valve and admitted into the cylinder air compressed to a high pressure, which lifted the piston, and thereby opened the valves of the sound-board. This arrangement of the apparatus, however, was expensive and unusual, and required the air to be considerably compressed; the inventor therefore soon modified it into a more simple shape, and one more akin to the general routine of organ manufacture. For the cylinder and piston he substituted a small bellows, which could easily be made of such a size as to give the requisite power without an inconvenient pressure of wind; and in this state the apparatus now remains. The key of the clavier opens a small valve, which admits the compressed air, furnished by bellows for the purpose, into a machine precisely similar to a pair of ordinary single hearth bellows, but only a few inches long and broad; the lower board of this is fixed; the upper one rises when the wind is admitted, and carries with it a rod, communicating with the whole of the valves, coupling movements, &c., which have to be moved, and which therefore answer immediately to the putting down of the key: when the key is released from the finger, the valve which admitted the air is shut and another opened, to allow of its escape; the bellows then immediately descend. It is easy now to see that the key is entirely relieved from the resistance of the main valves, couplers, &c., having merely to open the small valve of the pneumatic apparatus; and this is so light as scarcely to be felt by the finger. The touch, therefore, can be adjusted to any degree of elasticity convenient to the player,—all the resistance of the machinery beyond, being overcome by the auxiliary power. The effect, indeed, of this apparatus is to transfer the labor of playing entirely to the bellows-blower, leaving the organist at liberty to exercise, unconstrained by mechanical exertion, his more intellectual powers. The advantage of this can only be fully appreciated by those who have toiled under the fatigue of playing a large organ on the ordinary plan.* But, independently of this, it offers great advantages in the construction of a large organ, inasmuch as it removes all limits to the supply of wind, either as regards quantity or pressure, and gives, without the slightest addition of difficulty to the player, the power of adapting couplers and other mechanical contrivances, which, under the ordinary system, would become altogether impracticable. The three couplers already described in this organ, and the double arrangement of valves necessary to admit the higher pressure of wind to the reed-stops, are instances of the application of these advantages. The action of the pneumatic lever is instantaneous, rising and falling simultaneously with the motion of the keys; and the notes may be repeated with facility.†

The organ is tuned on a temperament more equal than is usual in England, by which the extreme sharp and flat keys are rendered better in tune.

The internal arrangement of the organ is somewhat novel, and contains several ingenious contrivances for simplifying the machinery, and rendering all the parts easily accessible.

The dimensions of the organ are 30 feet high, 12 feet broad, and 6 feet deep. The claviers are fixed in a detached upright console,—the player sitting with his back turned to the instrument itself. This arrangement is frequently adopted in Roman Catholic countries, for the sake of enabling the organist to watch the progress of the service in the church, and to introduce the required music at the proper times.

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* The organist at Haarlem is obliged to strip like a blacksmith for his usual hour's performance; and, at the end of it, retires covered with perspiration.

† Although the pneumatic lever was first used in France, it is an English invention. Mr. Barker is a native of Bath, and endeavoured, in the first instance, to introduce his apparatus in England, about 1832, or the time when the large organs of York and Birmingham were in course of erection. Experience, however, in large organs, was then wanting in this country, and his endeavours were unsuccessful; he therefore went to France, where the subject was better known, and where the value of the new principle was at once appreciated. It was introduced by M. Cavaillé immediately, in the great organ building at St. Denis (1841), and has since been applied, together with the improvements to which it has given rise, in a considerable number of large instruments in the principal churches of France. Shortly after the erection of the St. Denis organ, Mr. Barker took the management of the business of Messrs. Daublaine and Callinet, now Ducroquet, and has constructed some of the largest organs in France. Although, therefore, the organ we are now describing is built by French enterprize, and on the French plan, much of the constructive merit it displays may be claimed for England.

It is right to state that there are other claimants to the invention of the pneumatic lever.

M. Schulze, of Paulinzelle, near Erfurt, exhibits an organ of two claviers and 16 stops, namely:—

Lower Clavier.

1.	Bordun	Stopped 16 feet.
2.	Principal	Open 8 feet.
3.	Gamba	Open 8 feet.
4.	Hohlflöte	Open wood 8 feet.
5.	Gedact	Stopped 8 feet.
6.	Octave	Open 4 feet.
7.	Mixtur	Compound 5 ranks.
8.	Clarinette	Reed 8 feet.

Upper Clavier.

1.	Lieblich Gedact	Stopped 16 feet.
2.	Geigen Principal	Open 8 feet.
3.	Lieblich Gedact and Flauto traverso	Stopped Open wood } 8 feet.
4.	Geigen Principal	Open 4 feet.
5.	Flöte	Open wood 4 feet.

Pedal Clavier.

1.	Sub-bass	Stopped 16 feet.
2.	Octave-bass	Open wood 8 feet.
3.	Posaune	Reed 16 feet.

The compass of each of the manual claviers is 4½ octaves, C to F,—that of the pedals is a little above two octaves, from C to D. The organ to which the upper clavier belongs is not enclosed, and does not therefore form what we should call a *swell.*

The *Bordun* (bourdon) and *Gedact* are stopped wood pipes, corresponding with our "stopped diapason." The *lieblich Gedact* is the same, but on a smaller scale, and differently voiced. The *Principal* corresponds with our "open diapason." The *Gamba* and *Geigen Principal* are open metal pipes, of a small scale. The *Hohlflöte* is an open wood pipe, peculiarly voiced. The *Mixtur* consists of the octave, twelfth, fifteenth, nineteenth, and twenty-second, but contains no interval of the third. The stop marked No. 3, in the upper clavier, consists of two pipes; one being a stopped pipe, the other an open wood one, turned and bored of a *cylindrical form,* and called the *flauto traverso*: the upper part of this stop consists of pipes of double length, which overblow and speak their octave. The *Flöte,* on the upper clavier, is the same as the *flauto traverso.* There are only two reed-stops, the *Posaune* in the pedals, and the *Clarinette* in the great organ; they are free reeds, with conical tubes made of zinc, and covered at the top with thin gauze, by which the sound is softened.

There are two couplers, to bring the upper clavier upon the lower one: one of these acts on the unison note, the other on the octave below. The pedals act on the great organ,—but this is done by an internal movement, without pulling the keys down;—a great convenience, as it does not interfere with the hands.

The pedal clavier is constructed in a novel manner. Instead of lying in a horizontal plane, parallel to the floor, as is the customary plan, in this instrument the keys are disposed in the form of a curve, concave upwards; so that the notes at the extreme right and left of the clavier, stand higher than those in the middle: the object of this is to render these extremes more conveniently accessible to the feet, so that they may be played with less exertion and derangement of the body, than in the ordinary plan. The pedal keys are further apart, and broader on the face, than in English organs: their distance, from centre to centre, is 3½ inches, and they are nearly an inch broad; whereas, in England, they are usually made only about 2¼ inches apart, and half an inch broad. The larger dimensions are common in Germany.

The bellows are two in number, and of the single construction, each consisting of an upper and lower board, connected together with leather sides, similar to a pair of domestic bellows, but much larger, and provided with valves at the points of exit as well as entrance of the air. The lower board is fixed, and to the upper one is attached a lever, by which the bellows are raised and caused to draw in air from the atmosphere; when the lever is free, the weight on the upper board of the bellows forces the air into the wind-chests of the organ. The ends of the two levers project from the frame of the organ, at a short distance apart, and the blower moves them, not by manual labor, as with us, but by *stepping* upon them, and allowing the weight of his body to bring them down, and so raise the bellows. They are moved alternately, so that while one bellows is being filled, the other may always be affording its supply. This mode of blowing (somewhat resembling the working of a tread-mill) is common in Germany.

Most of the stops of this organ are particularly powerful; they are given more wind than in our organs, not by the pressure being greater in the wind-chest (for this is only 3 inches), but owing to the apertures at the foot and mouth of the pipe being much larger, and allowing the wind to pass through more freely, which, the pipes being voiced accordingly, produces a louder quality of tone.

Organs are built in great numbers in Germany, and are made very cheaply. This one is an example,—the value of it being estimated at only about 1400 thalers, or £210 sterling.

Messrs. A. and M. Ducci, organ-builders, of Florence, send to the Exhibition two instruments, possessing considerable novelty.

The first is an organ, the peculiarity of which is its small size in proportion to its contents. It has six stops throughout the usual compass of 4½ octaves on the keys, and an octave of notes extending down to 16-feet C on the pedals, and yet the dimensions of the instrument are only 5 feet 6 inches high, 3 feet 6 inches wide, and 1 foot 11 inches deep. The stops are,—

1. Unison or 8 feet open (the lower part stopped).
2. Octave or 4 feet.
3. Fifteenth.
4. Nineteenth.
5. Twenty-second.
6. Unison or 8 feet reed stop, or trumpet.

The pipes of all these stops are very ingeniously formed and arranged, so as to occupy the least possible space, and, at the same time, to be accessible for tuning. The pipes are fixed in their places by springs, so that the instrument may be transported entire, from place to place, without danger of derangement. The bellows possess a novelty in that the feeder (consisting of a moveable board between two fixed ones) is double-acting, supplying wind both by its upward and downward motion.

The principal novelty, however, is in the pedal notes, which, although 12 in number, beginning with 16-feet C, are all produced from one pipe, about 4 feet long, contained in the stool on which the organist sits. Messrs. Ducci have, in the first place, found a means of so varying the proportions and make, as to cause a stopped pipe, of 4 feet long, to sound a 16-feet note, of 8 feet a 32-feet note, of 2 feet an 8-feet note, and so on; and, secondly, they have made the same pipe speak different notes, by opening holes, situated at certain distances in one of its sides, on the principle of the flute and other orchestral wind instruments. By applying therefore the pedal keys to move valves covering these holes, the whole range of an octave of pedal notes is produced by a simple and inexpensive means; which, if perfected and extended, would certainly bring about a revolution in organ building. A great advantage, independent of the portability and cheapness, is stated to be, that the pipe, being of so much smaller a size than usual, consumes much less wind.

Messrs. Ducci have also applied this principle to the construction of a separate instrument, which they term the *baristate,* and which is intended to give grave tones in an orchestra.

It consists of three or four pipes, of the construction above described, with keys attached to open the holes in the sides. A bellows, worked by the feet or by a separate blower, furnishes the whole with wind. The compass is about two octaves, commencing, in one instrument, with the G, in another with the E flat, above 32-feet C. The wood sides of the pipe are so formed as to vibrate with the air, giving a powerful reedy reinforcement to the tone; which, however, can be varied in intensity, or stopped altogether, by means of a regulating screw. The size of the pipe giving, when entirely closed, the note C sharp of 16 feet,—is 4 feet long, 7 inches broad on the side where the mouth and the openings are placed, and 20 inches deep. Probably it is this great proportional depth that gives the increased gravity of the tone. This instrument has received high praise from Rossini and other celebrated musicians.

AGRICULTURAL IMPLEMENTS.

Agriculture, although an occupation which early taxed the industry of mankind, and one that, with a few unimportant exceptions, has been generally esteemed as an honorable pursuit, has, nevertheless, received little assistance from the sciences, until within a comparatively recent period. True it is that Mechanics early lent her aid to its advancement; but the appliances were, until our own times, of a most primitive character, and perhaps, with the single exception of the plough, we are indebted for none of our agricultural implements to the ancients. This implement being at once the most ancient, as respects its origin, and the most important in its results, will first claim our attention in reviewing the agricultural department of the Great Exhibition.

The earliest attempts to prepare the ground for the reception of seed probably consisted in raising and disintegrating the surface of the soil, by means of pointed instruments or picks, made of hard wood; for, even at the present day, we find that this practice prevails among some of the least civilized of the inhabitants of the world. But the laborious nature of this operation must have soon induced the cultivators of the ground to devise a more expeditious and effectual way of breaking up the surface of the soil, and thereby abridge their labor; for we have good reason to suppose that, at a very early period, an implement, closely resembling the modern plough in the principle of its operation, was employed for this purpose.

The invention of the plough has been attributed to Tubal Cain, the first worker in brass and iron. This worthy antediluvian, as tradition informs us, first directed his attention to the making of swords and spears from iron; but finding that, instead of being used as weapons of defence against wild beasts, they were employed by men to destroy their fellows, he sought a new field for the application of his skill, and found it in this branch of the peaceful arts. But be this as it may, there is no doubt that the plough is an implement that was used in the most remote ages, as we find that Moses prohibits the Israelites from yoking together an ox and an ass, to draw a plough; thereby clearly shewing that ploughs, or implements for turning up the soil, and drawn by beasts of draught, were in general use in his days;—in fact, among the imperishable monuments of Egypt, several representations of this implement have been noticed.

The oldest form of the plough which we have on record greatly resembles the pick already alluded to, and which, being attached to a beam, and having a handle to guide it, could be drawn along by men or beasts, and made to cut up the surface of the ground. The light Hindoo plough now in use in many parts of India, of which there are models and working specimens in the Indian department of the Exhibition, seems to differ but little from this old model.

With the exception of the rude forms sculptured on the monuments of ancient Egypt, we have no very clear notion of the precise form of the plough as used in very early times; but the records which have come down to us from the Greeks and Romans, contain, not only pictorial representations of the ploughs which they employed, but also accurate verbal descriptions of the construction and method of using their various implements of husbandry. An inquiry in this direction would not be without its interest, but we must confine ourselves to the more practical view of the subject.

The modern English plough, in its most simple form, may be thus described. A strong bar of wood or iron, termed the "beam" is affixed to an iron frame, generally known as the "body"; and at the bottom of the body is the "sole" or "sole-plate," which slides along the ground, and bears the principal part of the weight of the plough. At the front of the body, and at the lower part thereof, there is a projecting piece, called a "nose" or "spit," that fits into a recess in the back of a horizontal cutter, called the "share,"—the office of which is to enter and break up the soil. Behind the share, there is affixed to the body, on the right hand or off-side of the plough, a bent iron plate, termed the "mould-board," "turn-furrow," or "breast," whose duty is to turn over and deposit at the side of the plough the "furrow-slice" or earth displaced by the share. On the left hand, or near side, the plough carries what is termed a "land-side plate," which extends upwards from the sole-plate, and moves in contact with the unploughed land: hence the term "land-side." At the front end of the beam is an apparatus termed the "bridle" or "hake," to which the horses are yoked, and whereby the line of draught can be altered as required. The plough is guided by handles or "stilts," which are long bars, branching from and forming a forked continuation of the hind end of the beam; or else one of such bars is affixed to the beam and the other is fastened to the frame or body of the plough. Projecting downwards from the plough-beam, is an instrument termed the "coulter," fixed in an inclined position, in a vertical plane, a small distance ahead of the share;—its office being to sever, by a vertical cut, the strip of earth that is to be cut horizontally by the share and turned over by the mould-board. When ploughing ley ground and stubbles, another coulter, termed a "skim coulter," is attached to the beam, a few inches in advance of the common straight coulter. It may be described as consisting of a miniature share and mould-board, affixed to the lower end of a straight stem, which is connected to the beam in such manner as to admit of its being readily adjusted to the requisite depth. It cuts and turns into the furrow the herbage and rubbish upon the surface, which are then buried by the turning over of the furrow-slice by the mould-board or breast of the plough, leaving the land perfectly clean in appearance: the vegetable matter, by being thus buried, will, instead of living upon the soil and impoverishing it, decompose, and add to its richness. Another addition to the plough is the "drag-chain," which is simply a weighted chain, hooked to the side of the beam or to the straight coulter: it is drawn along the land on the off or right-hand side of the plough, and serves to pull the long manure, grass, &c., into the furrow, that it may be completely covered by the furrow-slice.

Ploughs of the above construction are called "swing ploughs." They are converted into "wheel ploughs" by the addition to the fore end of the beam of a small wheel, to travel upon the unploughed land at the near side of the plough, or by the addition of two wheels, a large and a small one,—the former to run in the furrow and the latter upon the unploughed land. Swing ploughs are cheaper and less complicated than wheel ploughs, require less power to draw them, and in the hands of an experienced ploughman will generally perform better work than wheel ploughs; but, on the other hand, the latter may be used by inexperienced men or boys, for the wheels serve as gauges to regulate the width and depth of the furrow-slice.

It appears, from ancient authors, that the Romans used ploughs with and without mould-boards, with and without coulters, with and without wheels, with broad and narrow-pointed shares, and also with shares, not only with sharp sides and points, but with high raised cutting edges in front: these were generally drawn by a pair of oxen, guided by the ploughman, without the aid of a driver.

The ploughs in use in different countries in Europe have undergone but little change for many centuries; and it is only lately that any attempt has been made to construct this implement upon scientific principles. There are now, however, a great variety of ploughs in use; and it may not be amiss to shortly state their peculiarities.

These may be best classified according to their uses:—1st. Those which cut and turn over the soil in continuous slices, and thereby prepare the ground for receiving the seed: in this class are included the "common or furrow-plough" (that just described), the "one-way, turn-over, or turn-wrest ploughs," as well as those for forming two or more furrows at the same time, and, lastly, "deep soil ploughs;" but, as the latter are generally used for trenches, we shall treat of them in connection with trench-ploughs. 2nd. "Moulding or double-tom, ridge, and universal ploughs," employed for forming ridges for turnips and other roots, setting out lands for common ploughing, opening surface drains (or as it is commonly termed "striking water furrows"), and moulding or earthing-up root-crops and peas or beans. 3rd. "Surface, skim, or paring ploughs," used for cleaning and pulverizing the surface of the soil, without turning in the weeds; also for paring grass-land preparatory to burning, &c.: with these may be classed the "broad-share, scarifier, and subsoil ploughs," which not only perform the work of skim or paring ploughs and scarifiers, but are also suitable for subsoiling, and therefore form a connecting link betwixt this and the next class. 4th. "Subsoil ploughs," which, as their name indicates, penetrate deeper than the common plough, and throw up the subsoil to the surface. And, 5th. Ploughs for forming channels, to carry off the water and drain the land: this class includes the "deep soil ploughs," "trenching ploughs," and "drain ploughs."

We shall commence our review of the agricultural implements contained in the Exhibition, by an examination of the swing and wheel ploughs, and shall then proceed to notice the other constructions of ploughs under the classified heads above enumerated. The swing and wheel ploughs in the Exhibition are exceedingly numerous. Of these the two-wheel plough of Mr. W. Busby, of Newton-le-Willows, Yorkshire, seems to claim precedence; as it is one of the implements included in the award of the Jurors, by which he has become entitled to the great medal. This plough also obtained a prize at York in 1849; at Leeds in 1849; and at Thirsk in 1850. The Report of the Royal Agricultural Society states, that it was tried on strong land with twenty-one other ploughs,—some with two wheels, some with one, and others working as swing ploughs. That it worked 9 inches deep, with a 13-inch furrow-slice—four horses drawing it in good style; whilst other ploughs, which were neither working so deep nor forming so wide a furrow by one or two inches, were with difficulty drawn at all by the same number of horses. It cut the land-side clean, made a level sole, kept the furrow more together, and turned it in better style than any other in the field. The plough is of iron; at about the middle of the length of the beam, a rod, which carries the draught-hook at its forward end, is attached; and it is supported in front by passing through an eye in the bottom of an upright rod, which extends upwards through a socket at the fore end of the beam, and is retained at the desired height by a set screw. The share fits on to the end of an inclined lever, which is supported at the upper part by a screw-bolt, projecting from the frame or body of the plough, and is adjusted (so as to bring the point of the share nearer to or further from the land-side) by turning two nuts upon the screw-bolt, one at either side of the lever. The share is retained upon the end of the lever by a hooked rod, the hooked end of which is inserted into a hole in the share, and the other end (which is screwed) passes through a hole in the hind end of the lever, and is furnished with nuts, for drawing the share tightly into its place.—This plan of securing the share (which is pretty generally adopted by implement-makers) possesses a decided advantage over the old plan of driving a peg through a hole in the share into a corresponding hole in the nose of the plough-frame; as there is no danger of the share coming off when the plough is at work, and yet the share may be readily removed, if required. Mr. Busby's plough has the ordinary coulter, skim coulter, and drag-chain appended to it: the coulter is carried by a square iron frame, which embraces the beam, and is fixed therein by a set-screw; the skim coulter is secured by its stem passing through two openings in the ends of a small iron clamp or staple, which fits on to the beam, and is fixed by a screw; and the drag-chain is fastened to the side of the beam, and provided with stay-chains to keep it to its work.

Two iron ploughs, exhibited by Messrs. J. and F. Howard, of Bedford, are included in the award to them of an Exhibition prize medal. These ploughs are designed to be worked by two horses and four horses respectively, and are distinguished by the marks X and XX. They are constructed upon the same improved plan; but the XX plough is of somewhat larger dimensions than the other, and is intended for stronger land and deeper ploughing. The improvements consist chiefly in giving the ploughs more equable proportions, and in forming the mould-board or breast of a peculiar taper and regular curve: by which means, the furrow-slice is made to travel at a uniform rate from the time when it is first cut until it is left in its final position; the power required to work the implement is considerably reduced; and the furrows are laid more evenly, and in the best form for the reception of the seed. The share is affixed to a lever neck of wrought-iron, the raising or lowering of which gives the point greater or less pitch or inclination as the share wears, or as the state of the land may require; and the lever neck is, by a patented improvement, tightened at the end, instead of by a bolt through the side. When raised or lowered, it is secured in a series of grooves; and the centre pin, upon which the lever works, is fixed to the neck, and takes its bearing close to the head or socket of the share, so that the top of the share is not raised above or depressed below the front of the mould-board or breast when moved into the higher or lower grooves. The draught-chain consists of two link-rods, connected together by a ring or link; the hindmost rod is secured to the beam just above the "throat" of the plough; and the foremost rod, to which the horses are yoked, is supported by a small upright rod from the fore end of the beam, as in Busby's plough: when ploughing stubbles, the hinder part of the draught-chain may be removed, and the other part fastened to the beam at the middle of its length. The axles of the wheels are made upon a new plan, so that no grit can enter, nor any oil or grease escape; and the upright bars that carry such axles are attached to the beam by holdfasts (or rods having an eye at the end to receive such bars), the stems of which slide horizontally through openings in the beam, and are fixed by set-screws when the wheels have been adjusted to the desired width.

Messrs. Hensman and Son, of Castle Works, Woburn, have also obtained a prize medal for a four-horse plough for deep ploughing. The principal wearing parts of the plough are made of cast-iron, and the beam, handles, &c., are of wrought-iron. The mould-board appears to be of a suitable shape to equalize the pressure from the point to the hindermost end, and to turn the furrow-slice without breaking it. The draught-chain is composed of two link-rods; it is fastened to the throat of the plough; and is supported by a suspension link from the beam, in advance of the ordinary coulter, in addition to passing through the eye of the rod at the fore end of the beam. The coulter is attached to the beam by an apparatus, patented by Mr. W. Hensman, which enables the ploughman to alter at pleasure the inclination of the coulter to or from the land-side of the furrow, and to or from the fore end of the beam. The round stem of the coulter is introduced through the eyes of two eye-bolts, which pass through a metal plate at the side of the beam, and each receive a screw-nut, by screwing up which, the stem of the coulter is drawn against a rounded bead or projection upon the plate; and, by screwing up one nut more than the other, the point of the coulter will be inclined nearer to or further from the land-side. The lowest eye-bolt passes through the beam, and serves as an axis on which the plate can turn, in order to move the point of the coulter to or from the fore end of the beam; and to the front end of the plate is jointed a screw, which passes upwards through a fixed eye-piece at the side of the beam, and receives a nut, by turning which the end of the plate is raised or lowered, and the inclination of the coulter adjusted. The skim coulter is connected to the beam by a similar arrangement, except that only one eye-rod is used to receive the stem of the coulter.

A prize medal has also been awarded by the Jury to Mr. W. Ball, of Rothwell, Northamptonshire, for an iron two-horse plough. This implement does not present any peculiar features of novelty in its construction; but it bears evidence of attention having been paid to the relative proportions of the various parts, the curvature of the mould-board, &c. It is named the "criterion plough," and obtained a prize of £5, in 1849, and another of £7, in 1850, from the Royal Agricultural Society of England.

Messrs. Ransomes and May, of Ipswich, exhibit a larger collection of ordinary or furrow ploughs than any other firm. The one most deserving of notice is the prize plough, marked Y. L. It is an iron plough,—the beam being made upon the "truss principle." It consists of two bars of iron, welded or united together at the fore end of the beam, and bolted at the hind end to the frame or body of the plough; the intermediate portions of the bars diverge from each other, and render the beam wider at such part; and these portions are kept at the required distance asunder by hollow iron distance-pieces or struts, through which screw-bolts extend, and, by the aid of nuts, bind the whole securely together,—thus forming a light beam, possessing great lateral strength. The share is carried by an adjustable nose-piece or lever, the forward end of which lies in a flat position at the front of the sole-plate; and from this point the lever gradually rises, until it reaches the back part of the frame or body, beneath the beam. The lever is mounted, just behind its nose, upon a horizontal centre pin, on which it is capable of moving up and down (to raise and depress the point of the share), and likewise of sliding sideways (to move the point to or from the land-side); and it is fixed in any desired position by means of a screw-bolt, which passes through a slot or opening in the frame and through the lever, and is caused to hold the two firmly together by binding nuts,—two of which embrace the lever, and, by shifting, allow of its adjustment laterally, while a third with the bolt-head firmly grasps the frame. The coulter is attached to the beam, between the two side bars of the same, by means of a lever, which is capable of turning upon a rod or axis at the hind end thereof; to the back part of the lever the stem of the coulter is secured by eye-bolts, which extend through slots (elongated to admit of the coulter being shifted sideways), and are drawn tight by nuts; and the fore end of the lever is fixed by screwing up a nut upon a screw-rod that extends through a slot in that end of the lever,—the slot being elongated to admit of the end of the lever being raised or lowered to alter the inclination of the coulter. The other ploughs exhibited by the same firm contain some or all of the above-described improvements.

Mr. Bentall, of Heybridge, Essex, exhibits a two-horse plough, marked N. G. H., which is of the same outward form as the old Goldhanger or Essex plough, but differs from it in its internal construction. The mould-board is made in two pieces, so that the front part can be readily replaced, if it is worn through before the other part. The pad is dispensed with in this plough. The share is fixed on the lower end of a lever, the upper end of which is attached to a screw-bolt, that passes through an eye upon the fore part of the frame or body, and receives a couple of nuts, one above and the other below the eye; and by screwing these nuts, the end of the lever can be moved, so as to elevate or depress the point of the share to the desired extent.

Messrs. Garrett and Son, of Leiston Works, Saxmundham, Suffolk, exhibit a couple of ploughs, made after the model of the Northampton plough, and having wrought-iron beams and handles, cast-iron bodies, and case-hardened shares. The coulter is connected to the beam by its stem being inserted into an eye at the end of a screw-bolt, which extends through a metal plate and through the beam, and is secured by a nut. The hole in the beam is cylindrical, to admit of the bolt turning therein; but the hole in the metal plate is square-sided, as is also the portion of the bolt that fits therein, so that when the plate is turned the bolt will turn also. A screw extends through a nut at the side of the beam, and bears upon a tail-piece that projects from the plate; so that by turning such screw the position of the plate, and consequently the inclination of the coulter, may be adjusted. The position of the point of the coulter, with regard to the land-side, is regulated by inserting wedges between the plate and the beam.

Messrs. Barrett, Exall, and Andrews, of Katesgrove Works, Reading, Berkshire, exhibit a very good iron two-wheel plough. Amongst their ploughs they also have a two-wheel Berkshire plough, with high gallows. The gallows consists of a light iron bar, bent in the form of a long horse-shoe; it is fixed by the two ends to a small iron carriage, which is supported by the two guide-wheels of the plough; and at the upper part of the gallows is an iron ring-piece, which receives the fore end of the beam, and is attached to the gallows at any desired height, by inserting pins through it into holes in the sides of the gallows. The arched top of the gallows is connected with the beam by a small chain; and the carriage is connected by a draught-chain with a hooked draught-rod, affixed to the body of the plough at the throat.

Messrs. Deane, Dray, and Deane, of Swan-lane, Upper Thames-street, exhibit one of Howard's J. K. ploughs, provided with a lever movement, to regulate the height at which the fore end of the beam is supported by the guide-wheels. The upright rods that carry the axles of the wheels slide through sockets or staples affixed to the beam, and are connected at the upper ends by a cross-piece, to which is fastened the end of a lever that extends backwards to the ploughman, and moves upon a fulcrum just before the coulter. By means of this lever, the axles of the wheels can be raised or lowered; and they can be retained in any desired position by inserting a pin through the hinder part of the lever into an upright bar, carried by the framing of the plough-handles.

Mr. J. Laycock, of Winlaton, Newcastle-upon-Tyne, exhibits an iron swing plough, the coulter of which passes upwards through a slot or opening in the beam, and is embraced by a staple, connected to the beam by a pin-joint; a screw passes through the front part of the staple, and bears against the forward edge of the coulter, so that, by turning the same, the inclination of the coulter may be adjusted; and the point of the coulter can be moved to or from the land-side by turning two screws, which pass through the beam and bear against each side of the coulter.

A plough is exhibited by Mr. W. Abbott, of Bideford, Devonshire, which is provided at the back with a wheel, between the mould-board and land-side plate, to run upon the soil, for the purpose of supporting the weight and diminishing the friction. Messrs. Wilkie & Co., of Uddingston, near Glasgow, also exhibit a plough, having a friction-wheel in the sole for ease of draught; and Mr. Pearce, of Poole, Dorsetshire, has a plough with a wheel let into the land-side plate for the like purpose. We may here likewise notice a plough exhibited by Mr. G. Hayward, of Crewkerne, Somersetshire, having a wheel behind, which not only serves as an antifriction wheel, but motion is communicated from the axle thereof to the two seed-wheels of a small drilling apparatus, attached to the plough.

Besides those above mentioned, there are twenty-three other British contributors of swing and wheel ploughs; but the implements they exhibit present no noticeable peculiarities which have not been already spoken of.

Among the foreign exhibitors, we find in the Belgian department a plough by M. Odeurs, of Marlinnes, to which a prize medal has been awarded. It has a short wooden beam, affixed at the heel to a wooden bar or foot, which inclines backwards slightly out of the vertical position, and carries at the upper end a single short curved handle. The share is formed in one piece with the fore part of the mould-board; this part is made separate from the hind part, which is hinged thereto; and the hind part is expanded to the desired extent by means of a short rod, attached, at one end, to the inner side of the mould-board, and, at the other, connected with an iron bar (that projects from the back of the wooden bar or foot) by passing a pin through a hole in the latter and through one of a series of holes in the former. The lower end of the wooden bar or foot is fixed to a block of wood, faced beneath with iron, which forms the sole of the plough and also the nose to receive the share.

M. Delstanche, of Marbais, Brabant, exhibits a plough that has obtained a prize medal. This plough is formed with a wooden beam, wooden frame or body, and a single wooden handle. As in the plough just described, one piece of iron forms both the share and the fore part of the mould-board; but the hind part of the mould-board, in place of being hinged, is bolted to the fore part, and is connected with the beam by iron strengthening rods or stays. The sole is a thick piece of wood, faced with iron. The plough is furnished with a hind share, which is a flat plate of iron of a triangular shape, connected, by an upright stem, with the hind part of the plough-body.

M. Berckmans, of Baesveld, shews a plough of similar construction, provided with a small guide-wheel or roller, which can be raised or lowered by the ploughman, without quitting his position at the heel of the beam. The roller is carried by an upright rack-bar or stem, which extends upwards through the beam; in the teeth of this rack-bar works a small pinion, affixed to a rod, which extends horizontally along a recess in the side of the beam (covered by an iron plate) to the heel thereof, and is there provided with a four-pointed or star-shaped handle; so that on such handle being turned, the pinion will raise or lower the rack-bar, and consequently the guide-roller.

In one of the ploughs exhibited by M. Denis, of St. Leger, Luxembourg, the ploughman can raise or lower the guide-wheel while the plough is at work, by means of a long horizontal lever (as in Howard's, before described), to the fore end of which is attached the stem that carries the axle of the guide-wheel.

In the Netherlands department there is only one plough, exhibited by M. Jenken, of Utrecht; and to this a prize medal has been awarded. It has a wooden beam, a single wooden handle, and an iron body or frame. The share may be described as a plate of iron, approximating in form to a long parallelogram, affixed by one of its long sides to a flat nose-plate, at such an angle to the central line or axis of the plough that one of the corners will form the entering point of the share. The curvature of the mould-board of this plough appears to be suitable for reducing friction and facilitating the turning of the furrow-slice. In this plough, and in some of the Belgian ploughs, a kind of wooden sledge, affixed to an upright bar, is substituted for the guide-wheel.

In the United States department, Messrs. Starbuck & Son, of Troy, in the State of New York, exhibit a number of well-made ploughs,—several of them highly ornamented. They all have wooden beams and handles; most of them are without coulters; the shares and mould-boards are of the common form; and they are of lighter make than those devoted to like uses in England. These ploughs do not possess any constructive peculiarities to distinguish them from our ordinary ploughs; but they are smaller and of less weight, and are evidently intended to do light work. In those which have guide-wheels, the wheel travels beneath the central line of the beam; and in some of those which are without coulters, a short upright blade or fin projects upwards from the land-side of the share.

Messrs. Prouty and Mears, of Boston, exhibit a plough with a share of a peculiar form, having a chisel-shaped point, and called "self-sharpening." They also have what they call a "sod and sub-loam plough," the peculiar feature of which is the application of a small mould-board and share to the beam, in advance of the ordinary mould-board and share, so that the same will act in a similar manner to the common skim-coulter,—the small mould-board and share differing from the skim coulter in being affixed to the beam in precisely the same manner as the large mould-board and share, and not by means of a long stem.

Messrs. Hall and Speers, of Pittsburg, exhibit a strong iron plough with an arched wrought-iron beam, to which an ear or lug that projects from the top of the mould-board, at its front, is bolted; and thus the mould-board is connected to the beam as well as to the plough body. A stout rod or stay connects the land-side plate and the mould-board together.

Numerous well-made ploughs are exhibited by Messrs. Allen and Co. of New York. In one the draught-rod is connected at the hind end by a staple with the beam near the breast; whilst its fore end is supported by passing through a hole in the lower end of a straight iron bar; this bar is secured to the fore end of the beam by a screw-bolt, passing through a long slot therein, and drawing the bar against a circular plate, affixed to the end of the beam; which plate has a series of radial notches formed around the outer part of its face, to receive two corresponding ribs on the back of the bar: thus, by means of the radial notches, the bar may be adjusted horizontally, vertically, or at any desired inclination; and its slot admits of its being slidden across the end of the beam, to shift the position of the draught-rod. The other single-furrow ploughs are of the ordinary construction.

In the French department, M. Bodin, of Rennes, exhibits four swing ploughs, of different sizes. The shares and mouldboards are of the common form; and each is furnished with a straight coulter, set in an inclined position in a socket affixed to the beam. The draught apparatus consists, firstly, of an upright rod, fixed at any desired height in a socket at the end of the beam, by inserting a pin into one of a series of holes made in the rod; from the bottom of the bar, at the off or right-hand side, a plate projects horizontally, having a series of notches on its upper edge; and the draught-chain (which is connected to a hook on the under side of the beam in advance of the coulter) has, at the fore end, a long link, that is slipped over the end of the notched plate, and fits in one of the notches: thus the direction of the line of draught is adjusted laterally by means of the notches, and vertically by shifting the upright rod.

M. Andre and Count de Brono-Bronski exhibit a strong plough, having a straight wooden beam, which gradually rises from the heel to the fore end; it is supported at that end by a heavy wooden frame (a substitute for the ordinary gallows), mounted on two large wooden wheels; and its height is adjusted by sliding in the upper part of the frame or carriage. A strong wooden bar or foot is affixed to the hind part of the sole and the heel of the beam, and terminates at the top in a single hooked handle. A small harrow is connected, by a chain, with the throat of the plough, and is thus caused to follow it.

Canada furnishes two ploughs. One is exhibited by Mr. Fleck, of Montreal; it is a light well-made iron plough, but presents no features of novelty. The second, exhibited by Mr. Hulbert, of Prescott, is a short plough of great strength, suitable for breaking up new ground, and performing other hard work. The beam and land-side plate are formed of one piece of iron, and resemble somewhat the shape of a horse-shoe,—one end of the horse-shoe forming the fore end of the beam, and carrying the drag-link, and the other end, which is shorter, being expanded into the land-side plate. The share is large, and the coulter is of considerable width. The beam is so short, that the fore end does not extend above eight inches in advance of the point of the share.

In the Austrian department, M. Horsky, of Libejic, Bohemia, exhibits a Bohemian swing plough. A bent iron plate, of nearly the same width throughout, constitutes both the share and the mould-board; the cutting edge is not brought to a point, but stands in a straight line at right angles to the course of the plough; and the plate is fastened, by a bolt at the top, to an iron frame or body, which is affixed to a straight wooden beam. The beam is composed of two pieces, connected together, a little ahead of the body, by a hinge-joint; but the parts can be fixed immoveably by a stay-pin. The fore end of the beam is supported by a fore carriage or gallows.

Prince Von Lobkowitz, of Eisenberg, Bohemia, exhibits a plough with a long straight wooden beam,—the fore end of which is connected, by a chain, with a two-wheeled carriage, in such manner as to admit of the carriage turning freely, and, at the same time, affording support to the fore end of the beam: the plough is thus left more like a swing plough, as regards the guidance of it. He also exhibits a plough resembling that of M. Horsky.

The Prussian department contains some small models of ploughs; but none of a proper size for use.

Several models of ploughs are to be found in the Indian department; and also two full-size ones. In one plough, the sole consists of a straight square-sided wooden bar, with an enlarged nose, to carry a thin metal share, of a triangular form, with the side-points turned downwards; the beam, which is affixed to the sole-bar, is made with a double or OG-curve, the lower part whereof reaches nearly down to the same level as the share; and, from this point, the beam gradually rises to its termination; and the plough is completed by a third piece of wood, which forms the handle, and is affixed, at the lower end, to the sole, which is mortised, to permit the beam to pass through it. The other plough consists of a wooden stake, which forms the handle,—a piece of wood, not unlike the share or plug of a mole-plough, which constitutes the share and plough body, and is mortised to the lower part of the handle,—and a long straight beam, which is mortised into the handle above the share, and rises therefrom to its termination.

Tunis furnishes a plough of equally rude construction. It consists of a stout wooden bar or sole, which carries an arrow-shaped piece of iron, with the head of the arrow at the front to form the share; the sole is morticed into the hind end of a stout curved beam; and into the same mortice the handle of the plough is fitted. The sole is also connected to the beam by an iron rod; and from the near or left-hand side of the sole a wooden peg, about five inches long, projects horizontally.

In the Egyptian department is a plough, constructed like the one from Tunis; but in this instance the beam and the handle are straight; and the share is an arrow-shaped piece of plate-tin, nailed upon the wooden sole.

DECORATIVE ART.

In the branches of this subject, which we have hitherto had under consideration, it will be remembered, that color is an essential element of the decoration; and, in this respect, the ornamentation of porcelain, and the production of designs in stained glass, claim a certain degree of kindred to pictorial art. We turn now to a class of decoration in which the ornamental effects are independent of the aid of color; in which, indeed, generally speaking, they assimilate rather to sculpture. In this style of art the effects are produced solely by light and shade, and are, so to speak, seen as a kind of *chiaro scuro*. The subject which we shall now bring before our readers is that of ornamental work in metals, particularly gold and silver.

The art of working in metals is one of extreme antiquity. We know by the remains of the most ancient people, the Egyptians, that they were acquainted with the process of melting metals, and preparing moulds, into which the molten metal could be poured, to give it any desirable form; at the same time, it is probable that the operations of the ancients upon the metals were confined to those comparatively fusible; for, if they were acquainted with the use of iron, it is not likely that they possessed the means of melting and casting it, as that metal is probably too resistant to the action of heat to have been manageable in their hands. At an early period the art of working in metals had reached a high degree of perfection in Europe; and the specimens left us of the art of the goldsmiths of the fifteenth century prove that it had, at that time, arrived at a development never since surpassed, if indeed it has ever been equalled. In an inferior style of art, ornamental metal work had been much employed at a date long antecedent to this; and perhaps as early as the twelfth century it had, in common with ecclesiastical decoration generally, reached almost its highest perfection, in point of fine taste and appropriateness of design. The metallic decoration of this early period is marked by the prevalence of elegant scroll-like patterns, interspersed with foliage similar to the designs seen in the background of stained glass windows of the same period. The twelfth and thirteenth centuries were perhaps, in England, the most brilliant portion of the mediæval ages with respect to ornament in metal. The reason for this must be sought in a combination of circumstances:—Firstly, at this period the employment of works in metal, in immediate connection with the person, was, to a greater or less extent, according to the means of the individual, universal. These were the ages of arms and defensive armour, and upon them, as the specimens still extant prove, the most elaborate skill and profuse expenditure were often lavished. In the thirteenth century the peculiar kind of armour called chain-mail was introduced from the Holy Land, where it had been first seen among the Saracens, a people who were, at that time, far advanced in many of the arts, and who were, even then above all, celebrated for the excellence of their works in metal, particularly their arms and armour. Another reason for the degree of perfection found in early decorations in metal, in respect to their merit as works of art, was probably the circumstance, that this formed one, and a very important one too, of the few outlets to the artistic feeling of the time. It must be remembered, that nothing in the shape of fine art, strictly speaking, had as yet begun to dawn upon the north of Europe; and that the only field in which that love of art (which, judging by the buildings and decorations of the period, must have existed in the breasts of the people) could be exercised, was in such works as now form the subject of our consideration. During the fourteenth century ornamental metal work continued to be employed chiefly in connection with church decoration; but, at this period, a higher order of art began to be united to these works. In the fifteenth century, the period of the Cinque Cento, as it is termed, the goldsmith's craft attained that perfection which has caused the works of the Florentine school to be regarded by succeeding ages as models of design and workmanship. The business of the early goldsmith differed essentially from that of the goldsmith of the present time. He was an artist in the strictest sense of the term;—he was a designer, a sculptor, a chaser, and an engraver; he was able to model for himself, and to produce, with his own hands, all the effects of which his art was susceptible. The consequence was, that the productions of that period are veritable works of art, bearing, at every point, the impress of the genius and manual skill of their authors. These ancient artists, like the contemporary architects, were full of that enthusiasm which, when properly directed, never fails to effect something beyond mediocrity; they were thoroughly imbued with a feeling for art, which rendered it the great object of their lives. Who that has ever read the famous Cellini's account of the execution of some of his most celebrated works can fail to perceive, that the whole soul of the artist was devoted to his profession? Let those of our readers who desire to know what such devotion can accomplish enter the Italian department of the Great Exhibition, and examine for themselves the beautiful ewer and plateau, produced by Cellini's own hands.

Although the working in gold and silver, with any high degree of artistic skill, is a much later art than than that of working in the more abundant metals, still we have several authentic examples of goldsmiths' work, of a very early date; these are but rude in their character, and, although of great value as specimens of ancient workmanship, possess little merit as works of art. Perhaps the most curious production of the kind remaining is, what is called "King Alfred's Jewel," now preserved in the Ashmolean Museum, at Oxford; it is a species of pendant, supposed to have been worn suspended at the neck, or used in fastening the mantle; it was found in the Isle of Athelney, near to where tradition tells us Alfred sought refuge at the cottage of the goat-herd. This curious relic is formed of fine gold. An effigy of the king is enamelled on the front, the back is engraved, and round the edge is a Saxon inscription to this purport:—"Alfred commanded me to be made." This is, perhaps, one of the oldest specimens of the goldsmith's work extant; and, as an example of the condition of art of this kind, at a remote period, it must be considered to possess great value. In the British Museum is another specimen of Saxon art, of a similar character; this is a massive gold ring, known as "King Ethelwolf's ring," but, like the jewel just mentioned, it will obtain more consideration in the eyes of the antiquary than in those of the student of decorative art.

The impulse given, by the labors of the Florentine school, to the art of ornamental metal work, continued to be felt in the following centuries, and is felt indeed even to the present time. It is to this period that we look as to a standard whereby the beauty and general merit of our own works is to be judged. We have, properly speaking, no style of our own; and it is not difficult to account for this: our goldsmiths are not artists but artisans; the designer and the workman are no longer one individual; but the designs of the artist have now to be interpreted by a workman, who, generally speaking, is content to reproduce them, according to a mechanical process, with a total absence of that feeling which always leaves distinguishable traces in the work. This is remarkably evident in the groups of statuettes produced in silver, for racing prizes, or similar purposes. As specimens of valuable plate, these may be very good; but, with reference to the art displayed in their execution, they seldom possess the least claim to merit. Some parts of the process of producing such works are so entirely mechanical, that, unless the workman be possessed by a very lively appreciation of the peculiar points in the original model, the spirit and life of the work are certain to be irredeemably lost; and it appears to us impossible to obtain from the hand of a second person a just and vivid interpretation of a work, the beauties of which depend entirely upon the exact rendering of the conceptions of their author.

In the production of subjects of the class we have just named, the French certainly take the lead. Their smaller works are characterized by a degree of delicacy and artistic feeling which we, in some respects, woefully lack. After a careful examination of the gorgeous display of silver and gold in the Exhibition, the impression is one of disappointment with respect to what may be called the fine art applications of these precious metals. If we turn, however, to a different class of productions, viz., ornaments of silver and gold intended for the decoration of rooms, or the service of the table, the effect on the mind will be more gratifying; for, in this branch, the English may incontestibly claim the superiority. Our rare mechanical skill may help us here; but, independently of execution, the ornamentation of much of the plate is in good taste; and, some specimens, which we shall take an opportunity of mentioning, appear to us admirable, both in style and workmanship.

In working in gold and silver, the artist is placed under the most favorable circumstances, to enable him to carry out to the utmost the spirit of his design. He is not like the porcelain painter, fettered by the natural difficulties which arise out of the peculiar material with which he works, and by the difficulties connected with the process itself;—the metal is well suited to the production of the effects he desires; it is sufficiently ductile to receive any form he chooses to communicate to it, and possesses hardness and persistency to retain every mark of his labor. Neither is it by casting only that the metal can be moulded to the will of the artist. Under the hammer it yields in every required direction;—its surface can be beaten into any desired amount of relief, and of any desired shape. The property of being thus obedient to the hammer has given rise, in the case of the ductile metals—copper, silver, and gold—to the elegant art called *repoussé*. In the French department, on the south side of the building, numerous specimens of *repoussé* work may be seen; some of them most elaborate in their character: they are produced, we believe, almost entirely by means of the hammer,—being first beaten up from the back, and then, with great care and skill, back again from the face, until the effect desired by the artist is completely attained. It is obvious that, in skilful hands, this art affords great scope for the full exercise of the talents of the artist. By the nature of the process, a breadth of effect and sketchy freedom of manner can be obtained, not easily reached by other means; and, at the same time, the most extreme minuteness may be arrived at, as the French specimens, mentioned above, will abundantly prove. To heighten the finish of the surface of the work, chasing, or any other similar process, may be employed. In speaking of this art of *repoussé*, we are led to notice the production of works of art in metal by the electrotype process, inasmuch as a great number of *repoussé* originals have been reproduced by the electrotype with singular success.

The discovery of this interesting process will, in all probability, be of great importance to the production of ornamental metal work from original models, which could, until now, only be copied by casting and chasing; but in such an application of the electrotype the real art of the goldsmith, so far from receiving any addition to its resources, is more likely to become altogether neglected. From the specimens we have examined in the cases of Messrs. Elkington and Co., it appears that form offers no obstacle to the production of objects by this process; the moulds employed seem capable of delivering the most complicated designs. Such being the case, it is clear that the whole merit and difficulty of the work lies in preparing the original model and mould,—the deposition of the metal having no reference whatever to art; the copy being, in fact, produced by a self-acting process, which, without any interference or effort on the part of the artist, gives an exact reproduction of the original. For goldsmiths' work there is positively no field in such a case; the copy being a veritable reproduction of the original, with all its sharpness and effect, even to the most minute touches of the tools employed. It must be evident that such a process furnishes the means of producing ornament in gold, silver, or copper, in a more effective manner than the old methods; and the electrotype copies, as they contain every line of the original work, may be expected to have that freedom which can only be expressed by the hand of the artist, and which, when the object is finished by a mechanical process, like chasing, is certain to be lost to a greater or less extent. Messrs. Elkington appear to have started with a proper appreciation of the necessity for uniting the resources of art to their own process. Many of the specimens they exhibit are equal in taste and design to the finest specimens of gold and silver-plate; and are, moreover, interesting as specimens of the capabilities of a process now only in progress of development.

In many of the works in silver, placed in the Exhibition, it will be observed, that the surface, instead of being polished or frosted, according to prevalent practice, is left dull, having what, at first sight, would be considered a somewhat unfinished appearance; a little closer attention will, however, discover that this condition of surface is intentional, and that it has been produced with as much care as could have been bestowed upon it were any other style of finish employed. This peculiar manner of treatment is employed by the French in their bijouterie,—it is termed *oxide* or oxidized silver. In the French department a great variety of small works, finished in this manner, may be seen, in which the dark colored silver is in fine harmony with the gold mountings. This oxidized silver is a most advantageous medium for the artist; his work is much more favorably rendered in it than in silver finished in the usual manner; as the whiteness and glare exercise ordinarily an injurious effect upon the artistic portion of the work, the feeling of which is certainly in some degree lost upon the spectator, in consequence of the excessive brilliancy of the material in which the object is executed. As an example of a work of high class, finished in the style we have just described, we refer our readers to a vase exhibited by Hunt and Roskell, of Bond-street: this vase is of Etruscan form, covered with figures in high and low relief; it is also a specimen of the kind of work termed *repoussé,* which we have already mentioned,—being entirely embossed from thin sheets of silver. The subject is the war of the Titans against the Gods; and, in point of execution, we consider it one of the finest specimens of metal working of this particular kind, in the Exhibition. It is in the table plate, however, that most of the best examples of ornamental metal work will be found; but, after all, these are deficient, generally speaking, in originality. We meet with tea services of the Renaissance, tureens, and caskets, of Louis Quatorze and Louis Quinze, and vases of the Etruscan style; and these, turn where we may, are repeated until we tire of the same shapes and manner of ornamentation. If we direct our attention to the works executed in the early days of art, how different is the impression produced upon the mind. Let us take, for instance, the decorated armour of the fifteenth or sixteenth centuries, what an endless variety of combinations of form and ornament we witness. Every individual work seems to bear the traces of the hand of a master; we can scarcely believe that these were but repetitions of works common before; for every one of them appears to present unmistakeable evidence of originality, and of a peculiar and well-considered adaptation to its purpose.

Among the best works in the Exhibition, in the precious metals, according to our judgment, are a fine tea service, by Durand, of Paris. In many respects, this is a work of great beauty; in addition to other peculiarities it presents some specimens of *niello,* an art which we shall further allude to. A table, in oxidized silver, by Poussielque, also of Paris, is another artistic work. On the English side we have, among a multitude of objects, the following, which attracted our attention:—vases in the Cinque Cento style, by Mayer of Liverpool; gilt chalices, of fine design and workmanship, by Dixon; a tea and coffee service, in gold and silver, of the time of Louis Quatorze, by Angell; some fine specimens of church plate, placed in the Mediæval Court, by Hardman; and, lastly, an elegant tea service, in the Florentine style, of the sixteenth century, executed in gold and silver; and a most artistic work, a table and vase, of Etruscan pattern,—the table of ebony, inlaid with silver, and the vase of chased silver. These and the tea-service last mentioned, are exhibited by Hancock, of Bruton-street. This table and vase are very fine, chaste and elegant in design, and beautifully executed.

While writing upon the subject of ornamental metal work, we are naturally brought to give some consideration to the art of enamelling, and painting in enamel. A distinction must, however, be drawn between the two, as we shall presently point out. The art of enamelling, like that of working in the precious metals, is one of great antiquity, and, from its peculiar character, came, at a very early period, to be held in high estimation. The great durability of enamel, the brilliancy of its effects, and the beauty of the colors, combine to render it highly suitable for certain kinds of ornament, to say nothing of its applications to fine art. Enamel is a substance analogous to glass; it is, indeed, a species of glass; and the process of making enamel in all probability arose at no great distance of time from the discovery of glass-making itself. The enameller's art is one in which considerable difficulties oppose themselves to the efforts of the artist; but these difficulties arise, not so much out of the nature of the process, as from that of the material with which the work is executed. All enamelling is executed upon a groundwork of metal, either copper, gold, or silver; but the enamel is of two kinds,—it may either be opaque, like the dial of a watch, or transparent, shewing the metal through, and resembling transparent colored glass, as we often see in bijouterie of different kinds. This latter sort of enamel is only executed upon gold.

The earlier kind of enamelling, of which many specimens still remain to us, differed very essentially from the enamel painting and enamelling in color of a later period. A fine example of this early enamel, belonging to a period as remote as that of the Saxon rule in England, is the jewel of King Alfred, before alluded to; but an examination of this curious relic shews that the enamel, which appears to be nothing more than a very fusible glass, is made to fill up cavities scooped out of the metal,—fine lines, or little partitions, as it were, of the metal, being left to mark the outline of the subject, and appearing through the different enamels employed to produce the effect. This kind of enamel may be regarded as a mosaic, rather than enamel painting. King Ethelwolf's ring is another specimen of early enamel;—the vitreous matter is here of a fine blue color, the lines of gold appearing through it.

In painting in enamel, a different principle is applied; the metal is first endued with a uniform coat of white enamel, and upon this the colored designs are afterwards produced; in fact, painting on porcelain and enamel painting assimilate closely to each other. The early Italian enamels were executed only in black and white; that is to say, the designs were produced in black, hatched and slightly shaded,—the faces and beards alone being tinted of a carnation color. Of this kind is the enamel of Limoges, as it is termed, of the period of François I.,—in whose reign, indeed, the art of enamelling was carried to great perfection. The chief difficulty in enamelling arises from the circumstance, that the colors are all derived from metallic oxides, which only develope the desired color after subjection to the action of the furnace; the use of the coloring matter is, consequently, entirely a matter of personal experience; and the most important operation for the enameller is the preparation of his palette. This is done by trials of different coloring materials, laid on enamel, and subjected to the same treatment as is necessary for the work itself. The results are carefully marked in correspondence with the metallic oxides from which they were obtained; and they are kept as a kind of text-book, for the guidance of the operator.

As examples of the command of color, obtainable by the enameller, we recommend our readers to examine the works of Essex and Bone, in the fine art department of the Exhibition;—we mention these only with reference to their execution as enamels, and not with regard to their merit as fine art works. Specimens of enamelling will also be found in the jewellery departments. In proceeding along the gallery in which the British gold and silver plate is deposited, the attention of the visitor may, perhaps, be attracted to a small work said to be a reproduction of an art of the fifteenth century, termed *niello*. Although at the present time this art occupies but a subordinate position, in respect to the work of the goldsmith, in the time of early Italian art such was not the case; and, as *niello* was probably the first germ of the art of engraving and printing from engraved plates—an art now so important in connection with the fine arts—we will briefly describe its character:—It is said by some writers, that the art of *niello* was known as early as the seventh century; but that about the twelfth or thirteenth centuries it was lost, and not again revived until the fifteenth century, at which period it was practised by Finiguerra, an eminent goldsmith of Florence. Strictly speaking, *niello* is neither more nor less than a kind of enamelling,—the only difference consisting in the manner in which the design is produced;—to make ourselves clear, we may say, that a *niello* is nothing more than an engraved gold or silver plate, in which the engraved lines are permanently filled with black enamel. The ancient art of damaskening bore some resemblance to *niello,* inasmuch as the designs were first carefully engraved by hand;—but, in damaskening, gold or silver were inserted into the engraved lines; while, in *niello,* the same are filled, as we have already stated, by enamel. In the best period of Florentine art, *niello* was employed in the decoration of chalices, pixes, reliquaries, handles of swords and knives, and other objects: some of these works are still extant. The most celebrated of them is a *niello* plate for a pix, executed by Finiguerra, in 1452; it is now in the Museum at Florence, and is considered the most valuable remaining specimen of the art. A cast in sulphur, from this celebrated work, was in the collection at Stowe; and an impression on paper from the same engraved plate, before it was filled with enamel, is in the *Bibliothèque du Rois,* in Paris. Another fine specimen of ancient *niello* is in the British Museum: this is a cup about nine inches in height; the *niello* is on silver, but the mountings of the cup are gold. In the process of producing *niello,* the progress of the work was examined by filling the lines with a black fatty material; and then pressing a mass of a peculiar kind of clay upon the design, so as to obtain an impression on the clay. In this we see a process exactly analogous to printing on paper from engraved plates. Nevertheless, the discovery of that application, although apparently so obvious, was ultimately effected only by chance. It is said that, on a certain occasion, a female, of the household of Finiguerra, entering his workshop, laid upon the bench, at which he was at work, a parcel of damp linen; it happened, accidentally, that a *niello* plate, which had been proved, as we have mentioned above, was lying upon the table, the black matter not being yet cleaned from the engraving;—the damp linen absorbed the black, receiving a perfect impression of the plate: this, when seen by Finiguerra, excited his surprise and delight, so that he went to work with fresh trials, and thus became the discoverer of the important and beautiful art of printing from engraved plates. The materials of which the enamel of *niello* was composed were silver, copper, lead, and sulphur, with borax for a flux. The engraving was thoroughly cleansed from adhering dirt and grease, and the above mixture was carefully worked into all the lines; the plate was then subjected to a sufficient temperature to fuse the mixture, which, consequently, flowed into every part, producing a compact enamel, through which, when the surface was polished, the white lines of silver shewed;—the design having the appearance of being executed in black upon a white bright ground; and the effect not being altogether unlike that produced in the Daguerreotype.

RECENT PATENTS.

To Henry William Ripley, *of Bradford, in the county of York, dyer, for improvements in dressing and finishing piece-goods.*—[Sealed 19th November, 1850.]

This invention of improvements in dressing and finishing piece-goods refers to a mode of improving the appearance of such fabrics, and, in the case of goods which are dyed black, of materially increasing the intensity of the tint.

The classes of goods to which the improved process is found to be most particularly applicable are those made with a cotton warp and worsted or woollen weft, and those which are formed of cotton and silk, or worsted and silk, or the three materials combined or separate.

The invention consists in applying oil or oleaginous matter, or saponaceous matter, to the surface of the fabric, after it has been dyed and finished, or partially finished, in the ordinary way,—such oil or oleaginous or saponaceous matter being imparted very sparingly to the fabric by means of a soft brush. In applying the oil by hand, it is first spread evenly upon a smooth flat surface, and the brush being dabbed thereon, will take up a small portion of oil on the points of the hairs. The brush, thus charged, is passed rapidly and repeatedly over the surface of the fabric under operation, until the oil is brushed well into the fabric; but, in order to carry on the operation with greater speed, the fabric may be submitted to the action of a rotary brush, supplied with oil or oleaginous or saponaceous matter in the ordinary manner of feeding printing-rollers with ink, or in any other suitable manner,—it being a point of great importance that the supply to the brush shall be so limited, that the amount of greasy or saponaceous matter imparted by the brush will, in no perceptible degree, saturate the fabric, but be present in an almost inappreciable quantity. The fabric is caused to travel slowly forward, and come in contact with the rotary brush; which, if revolving in the same direction that the fabric is travelling, must have a greater surface speed than the fabric,—the object being to submit the fabric to considerable friction as it passes under the brush; whereby an improved appearance will be imparted to the fabric. The oleaginous matter preferred to be employed is pure olive oil; but other inodorous oils or saponaceous matters, composed of fats and alkalies, may be used, if thought desirable.

Although it has been stated above, that the invention is particularly applicable to piece-goods, composed of two or more materials, yet it is found that goods produced from one material, and particularly woollen cloths, may also be dressed and finished, with advantage, in a similar manner. By submitting woollen cloths to this process, an additional lustre is imparted thereto; and when dyed of a dark tint, as black or brown, the brilliancy or intensity of the color is considerably augmented. When acting upon woollen cloths, or other goods requiring the lustrous appearance, it will be best to cause the brush to rotate in the direction in which the cloth is travelling, unless the back of the cloth alone is subjected to the operation: in which case the direction of rotation of the brush is of no consequence.

The patentee claims, as his improvements in dressing and finishing piece-goods, submitting the same to the action of a frictional surface or of frictional surfaces, supplied with oleaginous or saponaceous matter, for the purposes above set forth.—[*Inrolled May,* 1851.]

To WILLIAM EDWARD NEWTON, *of the Office for Patents,* 66, *Chancery-lane, in the county of Middlesex, civil engineer, for improvements in obtaining, preparing, and applying zinc and other volatile metals, and the oxides thereof; and in the application of zinc or ores containing the same to the preparation or manufacture of certain metals or alloys of metals,—being a communication.*—[Sealed 23rd July, 1850.]

THE first part of this invention consists in the use of improved furnaces for the reduction of zinc, and the manufacture of its white oxide.

This part of the invention embraces, first,—the system of reduction by means of cylindrical retorts, arranged in horizontal or nearly horizontal positions, and with the open ends of the retorts presented at one side of the furnace, as is practised in what is generally termed the Belgian method of reduction. In the Belgian furnace, the retorts are arranged in numerous horizontal or nearly horizontal tiers, having the fire-place beneath, surmounted by an arched cover of fire-bricks, which is pierced with several openings, in order to admit of a more diffused and graduated heat to the retort-chamber above; and this latter has also an arched cover above the retorts, and is pierced with several openings for the exit of the smoke and gases into corresponding flues, and thence into the chimney above. Now these openings at the upper part of the retort-chamber are productive, in operations conducted at such high temperatures, not only of much loss from the escape of heat along with the gases, but also of a want of uniformity therein,—the upper tiers being at a much lower temperature than those nearer to the arched cover next the fire.

To obviate these objections, and to ensure a greater uniformity of temperature throughout the furnace, the improved furnaces for the smelting of zinc are closed at the top, and the smoke and gases are made to ascend from the fire-place, and, after rising to the top or arch above the retorts, to reverberate, and descend to a flue or flues placed at or near the bottom of the retort-chamber, and leading to the chimney. By this arrangement, the heat is diffused more equally throughout the retort-chamber, and more economically applied to all the retorts than in the Belgian or any other furnace heretofore used for this purpose; and the operator is enabled to enlarge the capacity of the retort-chamber, and increase the number of retorts which may be operated upon by a given quantity of fuel.

In this description of enlarged furnace, a single fire-place may be used in the central part of the furnace: in which case the smoke and gases, after entering through the pierced arch over the fire into the retort-chamber, and parting with their heat among the numerous tiers of retorts therein, will be forced by the blast, or drawn by the natural draft of the chimney, downwards, through openings into the flues beneath at the right and left sides of the fire-place. Or, secondly, the furnace may be provided with two fire-places, one opening at each end of the furnace: in which case the smoke and gases, after passing through the openings in the pierced arches into the retort-chamber above, will be reflected by the closed arch above the retorts, and will make their exit, at the central part of the chamber, between two parallel walls, which rise somewhat above the lower tier or tiers of retorts, and which serve to conduct the smoke and gases to the horizontal flue beneath, whence they find their way to the chimney. This latter arrangement has an advantage over the former in the manufacture of the white oxide of zinc, inasmuch as the dust arising from the fires is removed from the central part to the two ends of the furnace, and is, consequently, more remote from the oxidizing openings in the pipes or chambers attached to the mouths of the retorts. By this means the dust which might otherwise be drawn into the retorts, and interfere with the purity of the products, is retained at a distance, and prevented from intermingling with the metallic vapors. In the reduction, however, of the fumes into metallic zinc, this matter is not of any great consequence.

An opening, with a door or stopper, in the outer wall, over and near to the pierced arch next above the fire, serves for the introduction of fire-tiles, which may be used as registers to each opening in the arch, and are intended to enable the operator to control the admission of the heat to the several parts of the retort-chamber. It is evident that, in order to economize space and materials, two furnaces, either with one or two fire-places, may be placed back to back, having but one rear wall, common to each, between them.

A single furnace, of the improved construction, is represented in Plate III., in which fig. 1, is a side elevation; fig. 2, a vertical section, passing through the two fire-places; fig. 3, a vertical section, taken at the dotted line A, *a*, of fig. 2; and fig. 4, is a vertical section of a modification, taken in the same plane as fig. 2.

a, *a*, represents the fire-places, with ash-pits *b*, *b*. The roofs *c*, *c*, of the fire-places, are made with apertures, to diffuse the heat and products of combustion; and these apertures can be opened or closed, and governed at pleasure, by means of a slate or register, which regulates an aperture in the outer wall. The retort-chamber *e*, is covered by an arch *f*, which reverberates the heat and products of combustion, and causes them to descend through a central descending flue *g*, to the exit flue *h*: the upper part of the flue *g*, is above the roof of the fire-chamber.

In fig. 4, the fire-chamber *a*, is in the middle; and there are two descending flues *g*, *g*, one on each side, but below the level of the roof of the fire-chamber, and with perforated slabs *i*, interposed between them and the retorts, to prevent the products of combustion from taking a direct course to the flues.

The front walls of the retort-chambers are composed of hexagonal forms or pieces *k*, of baked fire-clay and cement, or of other refractory material capable of withstanding the heat, which forms have open centres, of a circular shape: the wider ones are intended for the reception and support of the front or open ends of the retorts *l*, which rest on the inner edges of the forms, while their rear or closed ends rest upon similar forms, but of less width, attached to or composing part of the rear wall *m*, of the furnace. The forms constituting the front wall may be 6 to 9 inches in depth; two or three rows of which, arranged together, with central openings adapted to each front and rear, will give a conjoined thickness to the front of 18 or more inches; and the openings thus connected and adapted to each other, being thereby rendered of a sufficient depth, will constitute what is termed the cold or condensing chambers, in which repose the earthen or iron receivers of the usual construction; so that the fumes distilled from the ore in the retorts will be condensed and retained in a liquid state. Instead of two rows, the front wall may be constructed of single forms, of 18 to 20 inches in depth; but these are not so easily made, and they are more apt to warp. When the fumes are to be converted into white oxide, the cold or condensing chambers may be dispensed with; and a single row of forms, of 6 inches only in depth, will be sufficient, and will permit a more ready access of air to the openings, which, in this case, are left in the receiving pipes attached to the mouths of the retorts, for the conversion of the fumes into the oxide.

Besides the advantage of a more even temperature in these improved zinc furnaces, the patentee is enabled, by the confinement of the heat at the upper part of the retort-chambers, to give them a more elongated form and greater capacity, by spreading out the arch to an extent that will admit of a greater number of retorts beyond that worked in the Belgian furnace: as many as from 50 to 60 retorts, or more, may thus be worked to advantage, and with no increase of fuel, while in the Belgian furnace the number seldom exceeds from 45 to 47; and, by reason also of the greater regularity and uniformity of temperature, the loss by breakage of the retorts is considerably diminished.

Under this part of the invention the patentee claims the use of the improved furnace, above described (being an improvement on what is known as the Belgian furnace), for the reduction of zinc,—such improvement consisting in the arrangement of the fire-place or places, and the flue or flues, in such a manner that the products of combustion, after giving off their caloric to the retorts in the chamber, may be reverberated by the closed arch top, and carried downward and conducted away through openings situate at or near the bottom. And he also claims the use of furnaces, the retort chambers of which, for heating the retorts, are formed by making the front and rear walls thereof of hexagonal blocks or forms, with central apertures, to receive the ends of the retorts, as described; and this, whether for the reduction of zinc or other metals.

The second part of the invention relates to the use of another improved construction or arrangement of furnace for the reduction of the ores of zinc into oxides: in which furnace the cylindrical retorts, as described above, are dispensed with, and one large retort, muffle, or oven (constructed of fire-bricks, or of other suitable refractory material), is employed in place thereof. This retort, muffle, or oven, consists of one large chamber, to receive the ore to be treated; the upper part of this chamber is of an arched form, and the bottom is either flat or curved in the form of an arch or a series of arches; and the bottom and top are surrounded by flues for the passage or reception of the heated products of combustion from a furnace placed at the end or in front of the said oven.

Fig. 5, is a longitudinal vertical section of one form of retort, muffle, or oven, which has been tried and found successful; fig. 6, a horizontal section, taken at the line A, *a*, of fig. 5; fig. 7, is a longitudinal section at the line B, *b*, of fig. 6; fig. 8, is a cross section at the line C, *c*, of fig. 5; fig. 9, is another cross section, at the line D, *d*, of fig. 5; fig. 10, is a cross section of a modification, with the bottom of the retort, muffle, or oven, made of flat slabs instead of a series of arches; and figs. 11, and 12, are cross and longitudinal sections of a modification, with arched slabs forming bottoms between the bases of the two arches on each side. a^1, is the inside of the retort, muffle, or oven, to receive the ore to be treated; b^1, is the top, which is formed as an arch, of any desired curve; and c^1, is the bottom, which may be either a single arch, or a series of small arches, or composed of flat slabs. The two ends are closed with fire-bricks, or lumps made of fire-brick, and properly luted or cemented, or otherwise closed with cement, and provided with suitable openings for charging the oven with ore, or for conducting the fumes (as they issue from the oven) into a suitable condensing-chamber or chambers, as well as for stirring, manipulating, or withdrawing the exhausted residuum of the ore, The fire-place or grate *d^1*, with an ash-pit *e^1*, below, is constructed at one end of the oven (it may, however, be made at the side); and from it the products of combustion pass into a flue-space *f^1*, over the upper arch of the retort (formed by another arch *g^1*,); thence around the rear and down to two flues *h^1*, *h^1*, under the bottom and near the sides; then around the ends thereof, in front, into and through another flue *i^1*, under the bottom and between the two flues *h^1*, *h^1*, to the exit flue *j^1*, leading to the chimney, which may be common to several furnaces. Or, when the retort is composed of two concentric arches, as represented in figs. 11, and 12, with two arched bottoms *k^1*, *k^1*, uniting the bases of the two large arches at each side, then the products of combustion pass directly into a flue space under the bottom arch; thence, laterally, under the two arched bottoms *k^1*, *k^1*; and then through the flue over the top arch, which conducts the products of combustion downwards into the flues leading direct to the chimney. In no case must the fire-place be situated beneath the muffle or oven; as the arched bottom would be soon destroyed by the intense action of the heat.

Atmospheric air is admitted, in the following manner, into the retort, muffle, or oven, to oxidize the fumes arising from the ore:—The fire-bridge *l^1*, *l^1*, is made double or hollow (as in fig. 5,), with a narrow flue or space *m^1*, between the two parts; and this space *m^1*, communicates with the blast-pipe of a blowing apparatus, and leads to the upper part of the retort or oven, so that the supply of air shall, in its passage between the two bridges, become highly heated before it enters the retort or oven: this, however, may be dispensed with,—the air being introduced either in the cold state or from any other heating apparatus. There is an aperture *n^1*, at the back and near the top of the oven, communicating, by an appropriate pipe, with the receiver or condensing-chamber, constructed on the improved plan hereinafter described, or of any other suitable construction. This pipe has a valve or flapper *s^1*, near its bottom, for the admission of a further portion of cool atmospheric air. When so constructed as to have the fire-chamber communicating directly with the flue above the retort, the covering-arch will be highly heated; and then this covering-arch is to be employed for the purpose of a preparatory heating of the ore, which is to be spread to the required thickness thereon:—in such cases, a hole, provided with an air-tight stopper, is formed in the centre of the two arches, with a communicating tube *o^1*, fig. 5, through which the roasted ore can be directly charged into the retort.

By means of a retort, muffle, or oven, such as herein described, the ore to be volatilized can be spread in a thin stratum over the lower surface thereof, so as to be acted upon by the heat from above and below, and caused to give out its fumes more effectively and economically than in retorts of the usual construction; whilst, at the same time, the muffle or oven is more durable and less costly.

The patentee claims, as this part of the invention, the reduction of the ores of zinc into the state of an oxide, in an oven, retort, or muffle, connected with a fire-chamber, placed at the end or side of the said oven or retort, so that the said oven or retort shall be heated by the products of combustion passing through flue-spaces surrounding the oven; and, in which oven or retort, the oxidation of the metallic fumes is effected by the admission of atmospheric air through suitable openings.

The third part of the improvements consists in certain applications of zinc, or of ores containing the same, to the preparation or manufacture of certain metals, or alloys of metals.

The metals intended to be operated upon, or to be alloyed with zinc, are iron and steel, which are thereby rendered more malleable and less liable to oxidation. The process by which this combination of zinc with iron or steel is effected, and which constitutes the present improvement, is similar to that employed for converting iron into steel, and known by metallurgists under the name of cementation; whereas, the method now generally practised consists in simply fusing the zinc, and sometimes not only the zinc, but also the metal which is to be alloyed; in place of which the inventor raises the heat to the point of volatilization of the zinc, but not much beyond that of a red or bright red of the iron or steel. The zinc is used in its metallic state, or else in the form of such of its ores as are natural oxides (as, for instance, the red oxide of zinc, or franklinite,—which latter is properly an iron ore, but contains a considerable portion of oxide of zinc), or otherwise such of the prepared ores as are free from sulphur, arsenic, or other impurities or qualities detrimental to iron or steel. The ores or oxides, somewhat finely pulverized, are to be intermixed with charcoal, or other carbonaceous matter, to aid in their reduction, and may then be thinly stratified, in alternate layers, with the iron or steel, and heat applied to the mass in any convenient form of oven or furnace, having a vent or flue for the escape of such fumes or gases as may not be absorbed by the iron or steel. It is preferable that this process should be conducted under slight pressure, in order to retain the fumes or gases at a slight pressure in the furnace.

A suitable furnace for the purpose is that usually employed for the making of bar or blistered steel, and called the furnace of cementation. In the troughs or chests of this furnace the iron or steel may be stratified with the mixture of the ore or oxides and carbonaceous matter; and the chests should have suitable covers, arranged so that the vapors and gases may be retained under a slight pressure, and yet, in part, allowed to escape, as above stated. If the iron should be in a highly carbonized state, such, for instance, as pig or ordinary cast-iron, care should be taken that the carbonized matter be less in proportion than the equivalent required for the entire reduction of the zinc ore or oxides; which will, in that case, serve to aid in the withdrawal of the carbon of the iron; and it will thereby be brought more nearly into the state of malleable iron. If, on the contrary, steel is to be operated upon, the carbonaceous matter should be in excess, lest the steel be entirely robbed of its carbon. The heat to be applied need not exceed that of a bright red, which will be found sufficient; as iron and steel, and volatilized zinc, have an affinity at a moderate temperature. The heat should be discontinued as soon as or before the ores or oxides are entirely reduced; inasmuch as a further prolongation of it would only serve to dissipate that portion of the zinc which had previously united with the iron or steel.

When small articles of cast or manufactured iron and steel are to be operated upon, metallic zinc is sometimes employed; and a portion thereof is placed, along with those articles, in closed vessels or muffles, of earthenware, or of iron lined with clay or cement. These muffles or vessels may be introduced into an oven or ordinary annealing furnace,—the covers being first well luted on, in order to prevent, as much as possible, the escape of the fumes of the zinc. When luted or closed vessels are used, metallic zinc is preferable to the oxides and carbonaceous admixtures used for their reduction; as there would, in the latter case, be so great an escape of carbonic acid gas, as to interfere with the luting of the vessels. The heat may be continued until the vessels and their contents have been brought regularly throughout to a heat not exceeding a bright red; and then the fires should be withdrawn, and the muffles left to cool by degrees in the furnace.

The precise degree of heat and length of time to which the articles are to be subjected must depend on their size and substance, and the extent to which it is desired to alloy them: if of small and light substance, the zinc will penetrate throughout almost as rapidly as the pores of the metal are well opened by the heat.

The patentee says, he is aware that it has been heretofore proposed to alloy iron and steel with zinc, copper, and other metals, by various processes; and he does not therefore intend to claim the exclusive right of alloying iron and steel with zinc; but he claims, as the third part of the invention, alloying iron or steel with volatilized zinc, whether obtained from metallic zinc or from the ores thereof, as described.

The fourth part of the invention relates to the collecting or saving of the volatile products of the distillation or of the oxidation of zinc and other volatile metals, which it is proposed to collect in chambers or bags, constructed of closely woven cloth, of cotton, woollen, flaxen, or other fibrous or textile material, capable of separating and retaining the desired products, while the air or gaseous portion is to be forced or drawn through the pores of the cloth or strainer, by means of a fan, blower, or other suitable propelling or exhausting apparatus. This apparatus is to be placed in connection with a main or large tube, which communicates with several smaller pipes, adjusted to the retort or retorts, or to the condensing-chambers attached thereto, and is intended for the double purpose of drawing the vapors from the retorts as well as the atmospheric air, which is admitted (to oxidize the vapors) at a small opening in the oxidizing-pipe or chamber, near the mouth of the retort; and these pipes, with the main pipe, form the channel through which the oxidized products and accompanying gases are respectively forced into or through the pores of the bag, so that the air and gases may escape into the open air.

The main pipe is made of metal, and should be of sufficient length to permit the fumes and gases to cool before they reach the strainer or bag, so as to prevent them from burning the same. The end of this pipe communicates with the casing of a fan-blower; and the fumes and gases are drawn into the casing of the fan by the centrifugal action of its vanes, and forced out, through the spout or exit-passage, into the mouth of a long straining bag, made of canvas or other cloth, closely woven, of cotton, wool, flax, or other textile substance. Along the bottom, at convenient distances apart, the strainer is provided with branch pipes, of the same material, open at both ends, but which are to be tied at the lower end, to collect the products of the distillation; and when it is desired to discharge these branch pipes, they are to be tied up tight, near the strainer, and then opened at the lower end, and the contents allowed to fall out.

If the bag or strainer be composed of materials too slight to withstand the pressure on its inner surface, that pressure may be received by an exterior enclosing bag, formed of network, or of stouter materials, and made of somewhat smaller size than the inner bag. Should the pores of the inner bag or strainer become clogged, they may be relieved by striking or whipping it on the outside; or by stopping for a time the blowing or exhausting apparatus, and allowing it to collapse, and then shaking it; or by turning the bag inside out, and then applying the pressure to the opposite side. With regard to dimensions, it may be stated that a main tube, about 8 feet in diameter and 70 feet long, has been used for the collection of the white oxide of zinc from 60 small retorts; but with larger dimensions better results will be obtained; and, if deemed advisable, the diameter of the bag may be lessened, and its length increased in proportion. Instead of a bag, a square or oblong chamber may be used, having some portions of the top or sides formed of the straining-cloths. An air-tight chamber may also be employed, with a straining-bag adapted to its end, and passing into the interior of the chamber—the end of the bag being also in communication with the main or tube communicating with the retorts; and, on applying the exhausting apparatus at the other end of the chamber, the same object may be accomplished. Besides collecting the products of zinc, this straining apparatus may be used for similar useful purposes.

The above-described strainer is more especially adapted to the collection of the volatilized products of distillation when the same are to be saved in an oxidized state (such as the white oxide of zinc); but when such products are to be saved in the metallic form (as, for instance, in that of the blue powder of zinc), the fan, blower, or other such powerful exhausting apparatus, might cause the admission into the tubes, at their connection with the retorts, muffles, or oven, of a portion of atmospheric air, which should be carefully guarded against. In order to avoid this danger, and at the same time to give a moderate exhausting effect to aid in the withdrawal from the retorts, oven, or muffles, of the vapors, as they arise from the effects of the heat, it is proposed to attach thereto a pipe or pipes, made of sheet iron, or other good conductor of heat, and to elevate the opposite end thereof to such a height that the heated vapor and gases may be drawn towards the same with a moderate degree of force,—the gases being allowed to escape through a small orifice in the upper end of the pipe. The length of this pipe should be such, that the metallic vapors have time to cool and settle within the pipe before they reach the small opening provided for the escape of the gases. Instead, however, of elevating the end of the pipe furthest from the retort, it may be allowed to rest in a horizontal direction; and at the further end may be fixed a smaller vertical pipe, of the height of several feet, or sufficient to give the required draft for the escape of the heated gases: a register may be attached to this smaller pipe, to enable the workman to control the force of the draft. The main or horizontal tube must, as before, be of sufficient length to allow the metallic vapors to cool and condense before they reach the smaller pipe for the escape of the gases; and the products will thus be saved in the form of a metallic powder.

The patentee claims, as the fourth part of the invention, the use of a porous or fibrous bag, or receiving-chamber with porous sides, or an air-tight chamber with a straining or porous bag adapted to the inside thereof, and used in connection with either a blowing or exhausting apparatus; so that the products of the distillation and oxygenation of zinc, or other volatile metals, may be separated from the accompanying air and gases,—which latter will be forced or otherwise drawn through the pores of the cloth or strainer, and conveyed into the atmosphere. And for the collection of the blue or metallic powder of zinc, or the products of the distillation of other volatile metals, he also claims the use of the collecting or condensing pipe, with an elevated end and small orifice therein for the escape of the gases; or otherwise a horizontal collecting or condensing pipe, with a smaller ascending pipe at its further extremity, to aid in giving a moderate draft to the escaping gas, as described.

The fifth part of the invention relates to the preparation and application of the several ores and natural oxides of zinc, and also of franklinite, to the preparation of new and useful pigments.

These ores and natural oxides of zinc consist of calamine or the carbonate, of blende or the sulphuret, of the red oxide of zinc, and also of franklinite. Besides the oxide of zinc, the two last-named ores contain portions of the oxides of iron and of manganese. The franklinite contains much the largest portion of oxide of iron, and is better adapted to the making of a dark color, or (with the addition of a small portion of lamp-black, or other substitute for it) an excellent black pigment. The red oxide of zinc, with its natural admixtures of oxides of iron and manganese, produces a lighter colored, but still a rich dark brown. In order to lighten its tone, the iron may be extracted as follows:—First, the crude ore, as it comes in lumps from the mine, is slightly roasted, and then cooled, either by spreading it out in the open air, or by throwing water upon it—either of which processes renders it more friable and easy to be broken in its subsequent treatment. The ore may then be crushed between rollers or understampers, as is well understood, and subsequently ground in suitable mills until the largest particles are reduced to about the usual size of Indian meal, or of oatmeal; and it will be found that the largest particles consist of franklinite, while the red oxide of zinc will be in the state of fine powder, having also some finer particles of franklinite mixed with it. The larger particles of franklinite are then separated by passing the mass through a rotary cylinder, having fine bolting cloth adapted to its sides, or any other convenient form of sifting apparatus;—the finer portion of red oxide of zinc and franklinite being sifted through the interstices of the bolting cloth into one compartment, while the larger ones of the franklinite pass out at the end into another compartment. These two portions are then to be separately ground, either in the dry state or in water, to an impalpable powder. If ground in water, the products must subsequently be thoroughly dried in stoves or suitable kilns, and then re-ground; when they may be packed in kegs or vessels of convenient size for market, in the dry state; or they may, immediately after the bolting process, be ground with oil in suitable mills, and packed as before. The separated portions of the franklinite (or otherwise such distinct masses of the franklinite as may be brought direct from the mine, and are not mixed with any considerable portion of the red oxide) on being treated in the same way, form an excellent pigment, approaching to black, without the admixture of lamp-black; but the intensity of the black is much increased by the addition of about five per cent. of the last-named substance.

These pigments are well adapted to the coating of iron, tin, and other metallic surfaces, as well as of wood and stone. In order to give them a more powerfully adhesive property when applied to metallic surfaces, they are sometimes, after the first grinding and separation, roasted a second time in suitable kilns or ovens, with the admixture of carbonaceous matter, or with the access of a reducing flame or gases; they are carefully stirred during the operation, so as to bring them as regularly as possible to the state of sub-oxides; and, upon being ground with oil and applied to metallic surfaces, such as iron and tin, an electro-magnetic action ensues, which more closely unites the two metals, and has a very advantageous effect in protecting such surfaces from oxidation. These paints may likewise be rendered electro-magnetic by the admixture of about 20 per cent. of their weight—more or less—with the grey oxide, or with about ten per cent. of the blue metallic powder of zinc; but of course, in this case, there arises a corresponding variation in color. These electro-magnetic paints should be carefully packed, with as little delay and exposure to the air as possible, in order to prevent them from absorbing oxygen.

In order to obtain a more thorough separation of the franklinite than can be effected by the bolting process, it is proposed, after the first grinding, to roast the materials with the admixture of carbonaceous matter or access of reducing flame or gases,—carefully stirring during the operation, as described above, in order to bring each separate particle of the franklinite within the reducing influence of the flame, so as to render it magnetic; and then it may be effectually withdrawn from the red oxide by the use of rotary or other forms of magnets applied thereto. The materials may also be separated by the well-known process of washing and floating.

The other ores of zinc, consisting of the carbonate and sulphuret, are treated by a course of roasting, crushing, and pulverization by mills, whereby they are reduced to an impalpable powder, or by grinding with oil, as above described; but the roasting is preferred to be performed in the reverberatory furnaces usually employed to decarbonate or to pulverize them; and in order to give them an electro-magnetic property, for the better protection of metals, they may be mixed with the grey oxide or blue metallic zinc powder; or they may be brought into the state of sub-oxides, as before described, and subsequently protected from the air as much as possible until required for use.

Under the fifth head of the invention the patentee claims, First,—the fabrication and use of the pigments derived from the several ores of zinc, and of franklinite, prepared substantially as above described; and, Secondly,—the combination of the grey oxide, or of the blue metallic powder of zinc, with the pulverized ores or oxides, as described, in order to give them an electro-magnetic effect when applied to metallic surfaces, for the protection of the latter from oxidation.

The last part of the invention consists in the application of the ore, called franklinite, to the preparation or manufacture of iron from its ores, or in its subsequent finery, boiling, puddling, &c.; and, secondly, in the collection of the escaping fumes or products of zinc, which result from the use of this metal, or of its ores, or of franklinite, or other ores containing it, in such or similar operations.

Hitherto franklinite has not been deemed of much value for smelting purposes, owing to the difficulties attending its reduction; but the inventor has found, by experiment, that when mixed with other impure ores of iron in the blast-furnace, or in the Catalan forge, or with pig or crude iron, of hot short or cold short qualities (arising from admixtures of sulphur, phosphorus, silica, or other impurities), in the boiling or puddling furnace, these impurities may be wholly removed.

The franklinite may be broken to about the size of a walnut, or less, and charged into the blast furnace or Catalan forge, along with the iron ore to be improved, in the proportions of two per cent., or more, according to the effects intended to be produced. In some kinds of ores, such as bog ores, partaking largely of phosphorous and silica, two per cent. only has been found to produce a very marked improvement in the high or blast furnace; and a further addition, equal to 12½ per cent. in the whole, has afforded an iron of a remarkably superior quality. In the Catalan forge a somewhat larger proportion is required, on account of the more ready escape of the fumes of the zinc, which, in the high or blast furnace, are necessarily brought into contact with, and produce an effect upon, the superincumbent mass of ore above, whilst making their escape towards the mouth of the furnace. In the puddling or boiling furnace, when charged in along with the pig metal, it has been found that, in some kinds of the latter, which produce finished iron of the hot short or cold short qualities, the addition of 5 per cent. of the franklinite has entirely removed the latter defect, whilst 10 per cent. was required to remove the former. In other instances, a larger proportion, varying up to twenty per cent. or more, has been required; and the inventor has thereby frequently obtained from inferior pig metal the best quality or refined iron. The proportions must necessarily depend on the qualities of the ores or pig metal, which the experience of the workmen alone can determine. In the puddling or boiling operation, the franklinite should be broken to a size not exceeding that of a coarse powder. It may be charged in at the same time with the cinder and pig metal, or subsequently, just after the fusion of the latter and before it rises to the point of fermentation.

In all operations where franklinite or other iron ore containing zinc, or where zinc ore, or metallic zinc, is used, either for the reduction or for the improvement or galvanization of iron, at high temperatures, there must be a considerable volatilization and waste of the fumes in the state of oxide, &c.; and these it is proposed to save, in cases where the cloth or canvass strainer, or similar collecting apparatus, can be conveniently applied to the flues or furnaces used therefor. When the cloth or canvass strainer is employed for such purposes, a long flue, or otherwise a chamber or chambers, of masonry, or of masonry and cast-iron plates, or entirely of cast or of sheet-iron, or other good conductor, capable of withstanding the heat, should be placed so as to intervene between the furnace and strainer, in order that a sufficient portion of the heat may have time to escape by radiation, so as not to endanger the burning of the strainer. The fumes or gases being driven or drawn towards the strainer or receiver by the blowing or exhausting apparatus, a portion of the fumes or products of the zinc will settle in the chamber or chambers, whence they may be extracted through closely-fitting doors or openings, whilst the remaining portion will pass onward to the receiver or strainer, where they will be retained, while the gases will be forced through the pores or interstices, and make their escape.

Another mode of cooling the fumes and gases, on their passage to the strainer or receiving apparatus, is to cause a portion of the flue, through which they are drawn or driven forward, to descend perpendicularly for several feet, and at the uppermost part of the descent to introduce a stream of water, which should be broken or divided into small streamlets, or drop, like rain, to the bottom of the descent; whence it may make its escape through or near the bottom. It should thence be received upon a canvass or fibrous strainer, through the interstices of which the water will pass off, while such portions of the oxide as may have been carried from the flue by the water will be caught by the strainer. The oxide and gases which are not carried from the flue by the water will be drawn or impelled forwards through the flue, as it either takes a horizontal course, or resumes a perpendicular direction, towards the strainer or other suitable receiving apparatus. It is obvious, that if a sufficient quantity of water be thus made to fall from an adequate height within the flue, it will also act like the apparatus known by metallurgists as the "trompe" or "water-blowing engine," and may thus be made to supersede the necessity of a blower, or other blowing or exhausting apparatus.

The patentee claims, under this part of the invention, the application of franklinite to the improvement of iron in the processes of reduction from its ores, and in the finery or puddling of crude or pig-iron, according to the methods above described. Also the application of a suitable receiving or collecting apparatus, in conjunction with the intervening flues or cooling-chamber or chambers or apparatus, as above described, for saving the otherwise escaping fumes or products of the zinc. —[*Inrolled January*, 1851.]

To FRANCIS FREDERICK WOODS, *of Pelham-terrace, Brompton, in the county of Middlesex, builder, for improvements in paving.*—[Sealed 30th November, 1850.]

THIS invention relates to a mode or modes of combining wood and stone, either with or without other materials, for the purpose of forming the surfaces of streets, roads, ways, and other places, so that the objections incidental to pavements constructed of either of the materials alone may be obviated, and a good, useful, and durable pavement produced.

The improved paving is constructed principally of wooden blocks, with the grain of the wood inclining upwards; and in the top part of each block grooves, recesses, or indentations are made, to receive coarse gravel, broken stone, or broken granite, such as is used for macadamizing roads, and which, when properly compacted together, will cause the surface to present the appearance of a pavement composed partly of wood and partly of stone. In some cases, instead of using stone of the above-mentioned description, the patentee introduces into the grooves of the wooden blocks roughly-hewn stones of a more regular shape, such as are frequently employed for paving roadways.

He does not intend to confine himself to any particular form of wooden block, nor to the shape or arrangement of the recesses, grooves, or indentations to be formed therein for the reception of the stone; as their forms and arrangements may be varied without departing from the principle and object of the improvements; he has, however, shewn various plans of carrying the invention into effect.

In Plate III., fig. 13, represents a horizontal view of a portion of pavement formed of rectangular blocks of wood, of any convenient size—say from about six to fourteen inches on their surfaces, and about six inches deep. In the upper side of each block, deep parallel recesses or grooves *a*, are cut, as seen in the vertical section, fig. 14; which grooves may be about 2½ inches wide and 4 inches deep; and when the blocks are properly placed on the bed of the roadway, previously prepared for them in the manner hereafter explained, the grooves *a*, are to be filled with broken stones, as shewn, so that the surface of each block will present the appearance of about half wood and half stone. These wooden blocks are to be supported upon a substratum, composed of half-inch planking, laid on a concrete of lime and gravel,—the surface of the road having been previously levelled and properly prepared for the reception of the bed of concrete and substratum of planking. When the concrete foundation of the roadway has been prepared, the boards or planks are to be laid down close together lengthwise across the road. By these means the under-drainage will be materially assisted, and mud prevented from rising up between the blocks. The wooden blocks are then to be laid on the planked foundation, and the stones inserted into the grooves, as described, and sand, or fine gravel, mixed with ground lime, applied, to fill the interstices. In the employment of this construction of paving, having a boarded foundation, it will be found that the weight of the vehicles passing over the paving, and the effects of wear and tear occasioned by the traffic, will be more equally distributed over the surface of the road than when unsupported blocks are used. It will be found convenient to cut longitudinal grooves, about four inches deep and two inches wide, in the under-sides of the blocks used for the gutters or kennels, with side openings, for the purpose of receiving and carrying off the under-drainage from the other blocks to the nearest gully-hole.

Fig. 15, is a plan view of a modification of the above,—the only difference being that the grooves in the wooden blocks are filled with roughly-hewn stones (that is, stones partially squared), about three inches wide and four inches deep.

Fig. 16, represents a horizontal view of another modification of the improved pavement; and fig. 17, is a vertical section of one of the blocks shewn in fig. 16. In this instance, in place of long grooves being formed in the blocks, recesses, of any desired form, *b*, *b*, are made; and these recesses are filled with large gravel or broken stones, such as are used for macadamising roads. Between the interstices of the broken stone, in the recesses of the blocks, the patentee introduces ground lime, mixed with small gravel, either in a dry or liquid state,—the broken stones being rammed into the recesses by hammers or otherwise, so as to bring them level with the surfaces of the wooden blocks. Fig. 18, represents another modification of the above,—the only difference being that the wooden blocks are made hexagonal instead of square, as in fig. 4: the recesses in the blocks are filled with stone and concrete, in the manner last described.

Fig. 19, is a plan or horizontal view of a portion of paving, constructed in a different form and manner from any of those hitherto described. In this instance, the blocks of wood, to receive the alternate series of stones, are made from ordinary three-inch deal planks, which usually run eleven inches wide. These planks are cut into lengths of about six inches, so as to form rectangular pieces, which, when placed with the grain of the wood erect, will appear as shewn in perspective at fig. 20, say eleven inches by three inches on the upper surface, and six inches deep. These pieces of plank are to be placed side by side, each blocking the joints of those next adjoining, and lengthways crossing the road. Before these portions of planks are laid down, to constitute blocks in which the stones are to be inserted, angular pieces are cut off each, as shewn by dotted lines in the last-mentioned figure; and when a number of these pieces are combined, as shewn at fig. 19, and fastened together by any suitable means, zigzag grooves will be formed, in which the broken stones are to be inserted, in the way already described and represented in this figure, for the purpose of producing a pavement of wood and stone combined, ranging in zigzag lines from side to side of the roadway.

It will, of course, be understood that the same foundation or substratum of concrete and gravel, with planks or boards thereon, may be used, whatever the peculiar shape or configuration of the wooden blocks may be; and the employment of this foundation, as well as the use of a grouting or concrete, composed of ground lime and gravel, for filling the interstices, may, in some measure, be left to the discretion of the constructor, and must depend upon circumstances; as, in some cases, where the traffic is not great, a saving of expense may be effected by dispensing with the use of planks or boards for a substratum; but in all cases where the traffic is great, it is considered absolutely necessary that the directions above given should be adhered to as closely as possible.

The patentee claims, the combination of wood and stone for the construction of pavings for roads and other ways, as set forth and described.—[*Inrolled May,* 1851.]

To Edward Dunn, *of New York, but now residing at the London Coffee-house, Ludgate-hill, in the City of London, master mariner, for an improved engine for producing motive power by the dilatation or expansion of certain fluids or gases, caused by the application of caloric.*—[Sealed 26th December, 1850.]

This invention consists in producing motive power by the application of caloric to atmospheric air or other permanent gases or fluids susceptible of considerable expansion by the increase of temperature;—the mode of applying the caloric being such that, after having caused the expansion or dilatation, it is transferred to certain metallic substances, and re-transferred from these substances to the acting medium, at certain intervals, or at each successive stroke of the motive engine. The principal supply of caloric is stated to be thereby rendered independent of combustion or consumption of fuel; accordingly, whilst in the steam-engine the caloric is constantly wasted by being passed into the condenser, or by being carried off into the atmosphere—in the improved engine, the caloric is employed over and over again; and thereby the patentee is enabled to dispense with the employment of combustibles, excepting for the purposes of restoring the heat lost by the expansion of the acting medium, and by radiation, and for making good the small deficiency unavoidable in the transfer of the caloric.

In Plate III., figs. 21, and 22, are longitudinal sections of two arrangements of the improved engine, which are alike in all essential points, but differ in some of the details; and fig. 23, is a horizontal section of fig. 22. In fig. 21, A, and B, are two cylinders of unequal diameter, provided with pistons *a*, and *b*. A, is called the supply-cylinder, and B, the working-cylinder. a^1, is a piston-rod, attached to the piston *a*; C, is a cylinder, with a spherical bottom, called the expansion-heater, and affixed to the working-cylinder; D, D, are rods or braces, which connect together the pistons *a*, and *b*; E, is a self-acting valve, opening inwards to the supply-cylinder; and F, a similar valve, opening outwards from the said cylinder, and contained within the valve-box *c*, which is connected, by a pipe, with a cylindrical vessel or receiver G. H, is a cylindrical vessel, with an inverted spherical bottom, called the heater; J, a conical valve, supported by the valve-stem *j*, and working in a valve-chamber, which forms a communication between the expansion-heater C, and heater H, by means of the passage *d*; and K, is another conical valve, supported by the hollow stem *k*, and contained within the valve-chamber *e*. L, and M, are two vessels of cubical form, filled to their utmost capacity (excepting small spaces at top and bottom) with discs of wire-net or straight wires, closely packed, or with other small metallic substances, or mineral substances, such as asbestos, so arranged as to have minute channels running up and down: these vessels L, and M, with their contents, are called regenerators. *f, f, g, g,* are pipes, forming a direct communication between the receiver G, and the heater H, through the regenerators; N, N, two ordinary slide-valves, arranged to establish alternate communications between the pipes *f, f,* and *g, g,* and the exhaust-chambers O, and P; *h,* a pipe, communicating between the valve-chamber *e,* and exhaust-chamber P; *i,* outlet-pipe, leading from exhaust-chamber O; Q, pipe leading into the receiver G, provided with a stop-cock; R, R, fire-places for heating the vessels H, and C; and *l, l,* flues, leading from said fire-places and terminating at l^1. S, is a cylindrical vessel, attached to the working piston *b,* having a spherical bottom, corresponding to the expansion-vessel C: this vessel, which is called the heat intercepting vessel, is to be filled with fire-clay at the bottom, and ashes, charcoal, or other non-conducting substances towards the top,—the object being to prevent any intense or injurious heat from reaching the working piston and cylinder. T, T, represent brickwork, or other fireproof material, surrounding the fire-places and heaters.

In figs. 22, and 23, the same letters of reference are used for similar parts; and there are several additional parts, which are marked as follows:—U, is a rocking-shaft, supported, at both ends, by appropriate pillar-blocks or bearings *m*; *n*, is a crank, projecting from the centre of such shaft, and connected, by a link *o,* with the working piston *b*; V, is another crank, on the extreme end of the rocking-shaft, connected by a rod W, with a crank X, on the shaft Y; and Z, represents the circumference of a fly-wheel, paddle-wheel, propeller, or other rotary instrument to be worked by the engine. Before describing the operation of the improved engine, it should be observed, that the piston-rod a^1, only receives and transmits the differential force of the piston *b,* viz., the excess of its acting force over the re-acting force of the piston *a*; and this differential force may be communicated to machinery by any of the ordinary means, such as links, connecting-rods, and cranks; or it may be transmitted directly for such purposes as pumping or blowing. The conical valves K, and J, (fig. 21,) may be worked by any of the ordinary means, such as excentrics or cams; provided the means adopted be so arranged that the valve K, will begin to open the instant that the piston *b*, completes the up-stroke, and be closed again the instant the piston completes the down-stroke; whilst the valve J, is made to open at the same moment, and to close shortly before, or at the completion of the up-stroke. In like manner the slide-valve N^1, (fig. 22,) is to open and close as the piston *b*, arrives, respectively, at the termination of its up and down-stroke, similar to the slide-valve of an ordinary high-pressure engine. It will be seen, that the link *o*, like the piston-rod a^1, only transmits the differential or useful force of the piston *b*.

The operation of the engine shewn at fig. 21, is as follows:—Before starting, fuel is put into the fire-places R, R, and ignited,—a slow combustion being kept up until the heaters and lower parts of the regenerators are brought to a temperature of about 500° by means of a hand-pump, or other similar means; and air is then to be forced into the receiver G, through the pipe Q, until there is an internal pressure of eight or ten pounds to the square inch. The valve J, is then to be opened; when the pressure of the air that enters beneath the piston *b*, will cause the same to move upwards; and the air contained in the cylinder A, will be forced, by the piston *a*, through the valve F, into the receiver. The slide-valves N, N, being previously so placed that the passages *f*, *f*, are open, the air from the receiver will pass through the wires in L, into the heater H, and further into the expansion heater C,—the temperature of the air augmenting, and its volume increasing, as it passes through the heated wires and heaters: the smaller volume, forced from the cylinder A, will, in consequence thereof, suffice to fill the larger space in the cylinder C. Before the piston arrives at the top stroke, the valve J, will be closed; and, at the termination of the stroke, the valve K, will be opened. The pressure from below being thus removed, the piston will descend, and the heated air in the cylinder C, will pass through *e*, *h*, P, and *g*, into the regenerator M; and, in its passage through the numerous spaces or cells formed between the wires, it will part with the caloric gradually,—falling in temperature until it passes off at *i*, nearly deprived of all its caloric. The commencement of the descent of the piston *a*, will cause the valve F, to close and the valve E, to open; and thereby a fresh charge of atmospheric air is admitted into the cylinder A. At the end of the down-stroke, the valve K, is closed and the valve J, again opened; and thus a continued reciprocating motion is kept up. It will be evident that, after a certain number of strokes, the temperature of the wires, or other matter contained in the regenerator, will change: that of M, will become gradually greater, and that of L, diminish. The position of the slide-valves N, N, should, therefore, be reversed at the termination of every fifty strokes of the engine, more or less; and then the heated air, passing off from C, will pass through the partially-cooled wires in L; whilst the cold air from the receiver will pass through the heated wires of M, and, on entering H, will have attained nearly the desired working temperature. In this manner the regenerators will alternately take up and give out caloric; whereby the circulating medium will principally become heated independently of any combustion after the engine shall have been once put in motion.

The operation of the engine represented at figs. 22 and 23, is like that just described;—excepting that the regenerator is arranged in a single vessel, and that the metallic substances therein take up the caloric from the air that leaves the working cylinder or vessel C, and return the same to the air that enters the working cylinder at each stroke, instead of transferring and re-transferring the caloric at intervals, as in the other figure. The manner in which the differential or useful upward force of the working piston *b*, fig. 22, in conjunction with its descending power, caused by gravity, are made to impart rotary movement to the crank-shaft Y, will be self-evident on examining the disposition of the working gear of the engine. The relative diameters of the supply and working cylinder will depend on the expansibility of the acting medium employed: thus, in using atmospheric air or other permanent gases, the difference of the areas of the pistons may be nearly as two to one; whilst in using fluids—such as oils, which dilate but slightly—the difference of area should not much exceed one-tenth. When any other medium than atmospheric air is employed, it is indispensable to connect the outlet-pipe *i*, and the valve-box *k*, of the valve E, by a pipe, as indicated by dotted lines. The air or fluid escaping at *i*, will, when such a connecting pipe has been applied, furnish the supply cylinder, independently of other external communication; and the acting medium will perform a continuous circuit through the machine. It is evident that the working cylinder may be placed horizontally, or otherwise; and that it may be made double acting; and that a heat-intercepting vessel may be applied at each end of the working piston; as also an expansion heater at each end of the working cylinder. The patentee does not, therefore, confine himself to the above details.

His claims are as follows:—"First, I claim the structure which I call the regenerator, by which I effect a transfer of the caloric, contained in the air or other circulating medium that passes off from the working cylinder, to a series of discs of wire-net, or to other minute metallic or mineral substances, for the purpose of being again transferred to the air or other circulating medium that enters the working cylinder—whether said structure be so arranged that the metallic or mineral substances are made to take up and again return the caloric at each successive stroke of the working piston, as in fig. 22,—or whether it is so arranged that the transfer and re-transfer of the caloric takes place at intervals, as in fig. 21,—or whether said structure is arranged in any other manner for the purpose of accomplishing substantially the purposes hereinbefore mentioned. Secondly,—I claim the combination of the expansion heater with the working cylinder, by which the fall of temperature, consequent upon the expansion of the air or other circulating medium during the upward movement of the working piston, becomes restored; and by which also the force of said piston becomes augmented beyond what it would be if the accession of caloric, effected by the expansion heater, did not take place. Third,—I claim the heat-intercepting vessel, attached to the working piston, by which any injuriously high temperature is prevented from reaching the packing of said piston; and by which also the very desirable end is attained of presenting at all times surfaces of uniform high temperature to the acting medium under the working piston. Fourth,—I claim the inverted position and open ends of the working and supply-cylinders, as represented in the drawing. Fifth,—I claim the direct attachments of the working and supply-pistons, by which not only the acting and re-acting forces may be uniformly distributed over the area of each piston, but by which also the entire differential power of the working piston is rendered available,—less only the friction of the packings."—[*Inrolled June,* 1851.]

PATENT LAW REFORM.

Very different has been the issue of the struggle for patent law reform to that anticipated by all parties who were anxiously watching the result. To those personally interested in the retention of the old system, with all its crudities, the alarming progress of the bill, first through the House of Lords, and then the Commons, had afforded well-grounded fears that their snug berths would soon share the fate of many others, which our political economists have already shewn could be dispensed with, without danger either to the British constitution or even to the public service. On the other hand, the number of inventors who had hoped against hope were assured into almost certainty that their emancipation was at last on the eve of accomplishment. But, when the bill came up for the third reading in the Commons, after having been amended in Committee, so nicely did the balance of probabilities hang, as to its passing, that we are told by the *Times*, that the advocates for the postponement of the measure looked for success rather by the traverse of the hands upon the dial than by an adverse decision of the House on the policy of carrying it through;—to such a degree had the government jeoparded the hopes of inventors by their unseasonable alterations in the bill. It was not therefore to be wondered at, that, when brought back to the Lords on the last day of the sessions for their approval, cut and hacked about as it was, with thirty-one new clauses appended—the whole forming, as it were, from the impossibility of getting it printed in the time, "a thing of shreds and patches"—there should exist some squeamishness on the part of their lordships to recognize in the bill the little bantling which they had with such care reared at the early part of the session: the course, indeed, considering their province, could be no other than to reject it and leave inventors to the operation of the existing laws. Now, whether the new clauses introduced into the bill in the Commons, for the purpose of altering its administrative provisions, were judicious or not, we shall not stay to enquire, as it will be time enough to consider them if the bill, in its amended state, is ever again brought before parliament; but it certainly is somewhat perplexing to understand why the system of administering the patent laws, as proposed by the government and approved by the Lords, should, at the last moment, have been wholly changed without any apparent reason, and that at the risk of the measure being lost. It is undoubtedly a subject for regret, that the many who had been induced to exhibit their inventions in the Crystal Palace, from the temporary protection held out to them by provisional registration, should be thus disappointed of their reasonable expectations of obtaining further security by patent at a reasonable rate; but we would far rather this should have happened than that the patent bill as it came from the Lords should have passed into a law. For our own part, we think it easier to submit to abuses of old standing than to bear with newly-contrived means of oppression; and what could be more detrimental to inventors than to grant them patents with a proviso that made their validity rest on the impossibility of finding evidence, whether corrupt or otherwise, to prove prior knowledge of the discovery abroad? Not only was the clause which contained this provision most unjust, as viewed under this aspect, but original inventors, if (as prudent foreigners would naturally do) they had worked their inventions abroad before introducing them into this country, would not be entitled to a patent. It is not a little remarkable that, although most of the witnesses examined before the Lords' Committee spoke strongly against this clause, some even pointing out minutely the evils which it would create, yet it was retained in the bill; and that to a witness, who was perhaps the warmest advocate for its retention (Mr. Ricardo), the credit is due of getting it struck out in the Commons. There is, we fear, little to congratulate the inventive and manufacturing interest upon in the recent well-nigh successful attempt at re-modelling the patent laws, for it has given occasion for the revival of an obsolete notion, howbeit under a new and most insidious aspect, that patents are grants for the benefit of individuals to the detriment of the public. This was precisely the opinion held by the judges some fifty years ago, and acted upon so far as the law would allow; whereby patent rights, when brought into court, were knocked down like ninepins, and with as little remorse.

Of late years the application of professional skill to the drawing of specifications has given a marketable value to patents; for, by clearly defining the nature and scope of the inventor's rights, a more healthy feeling on the part of the public has arisen, which, together with a removal, in great part, of that ground of invalidity—a defective and incomprehensible specification—has not been without its effect in bringing the courts to look with a favorable eye upon inventors. An opposition now, however, appears to be threatening, which is not content to avail itself of quirks and turns in law, to break down monopolies singly, but beards the supposed despoilers of the public in the gross, and plainly tells them that civilization has advanced so far as to render these bribes to industry no longer expedient. That there is much to be said in favor of this view of the case we cannot deny; but that there is more to be said in support of the policy of granting patents for inventions we are perfectly satisfied. We have, therefore, no fear that, ultimately, the fallacy of this revived doctrine will be made evident; but, in the meanwhile, it may have its effect; and, the pressing necessity for patent law reform passing away with the occasion which gave it birth, we may, in the year 1852, be, to all appearance, as far as ever from obtaining a good working measure. It behoves, therefore, the inventive interest in the large manufacturing towns, to act with promptitude and energy in the early part of the next sessions of parliament, if they are desirous for patent law reform,—for, by doing so, they may not only anticipate the opposition which will undoubtedly increase against the granting of exclusive privileges, but also enable those who have exposed their inventions in the Great Exhibition, under the supposition of getting substantial protection, to patent their improvements at a reasonable rate before their provisional registrations shall have expired.

INSTITUTION OF MECHANICAL ENGINEERS, BIRMINGHAM.

The Special General Meeting of the Members was held at the Rooms of the Society of Arts, John-street, Adelphi, London, 30th June, 1851,—Mr. J. E. McConnell, Vice-President, in the Chair.

The following supplementary paper, by Mr. Joseph Beasley, of Smethwick, near Birmingham, was then read:—

On a new machine for blooming iron.[*]

The purpose of this machine is the blooming of the iron from the puddling furnace, in a more rapid, effectual, and economical manner than is accomplished by the usual process of hammering or shingling: the machine is the recent patented invention of Mr. Jeremiah Brown, a roll-turner, late of the Oak Farm Iron Works, Dudley.

Other methods have been invented and employed to supersede the hammering process, some of considerable ingenuity and merit; still, unscientific, ancient, and rough as the process is, shingling or hammering obtains general preference in the blooming of iron; and it has been generally contended hitherto, that the hammer excels all other means for ridding iron of its native impurities. This might perhaps be admitted, with reference to all other methods hitherto introduced; but for the present machine, differing as it does in construction and action from any one hitherto contrived, there is claimed a decided superiority, in all respects, over the hammer and every other working process, for the operation in question.

The blooming of iron is that process which the metal undergoes immediately upon its removal from the puddling furnace, whereby, as effectually and expeditiously as may be, the metal is consolidated into a homogeneous mass, free from dross or cinder. The principal objection to iron, made by the ordinary squeezers, is the quantity of cinder which is lapped or enclosed in it; whereas the object of squeezing, compressing, and hammering, alike is to separate and express the cinder, which, in proportion as it remains in the bloom, injures its quality, destroys the fibre of the iron, and prevents its uniting in a complete and uniform manner. It is the process of blooming, in fact, which fixes the character and quality of the iron; since no impurity can be thoroughly eliminated by any after process.

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[*] For former notice of this machine, see p. 76 *ante.*

This machine, it will be remembered, consists of three large spiral-shaped rolls, placed horizontally, and rotating all in the same direction; the ball of iron from the puddling furnace is dropped into the three-sided space between the three rolls, which forcibly compress the ball, giving it a rotating motion; and they have a very powerful kneading action upon the iron,—effectually squeezing out the cinder, which flows freely away down each side of the bottom roll. The space between the rolls gradually contracts, from the spiral form of the rolls; and thereby an increasing compression on the iron is maintained on all sides and the ends, until it is liberated by the extreme projections of the rolls passing the bloom, which drops out of the machine at the same moment that a second ball is put in at the top. The journals of one of the rolls are made to slide back, to prevent injury when any extra size of ball is put into the machine; and they are pressed down by a balance-weight acting on two large triple-threaded screws, maintaining a constant pressure on the roll; so that a large or small ball (within ordinary limits) is worked with the same pressure and in as effective a manner as the regular size of ball.

An important advantage of this machine is the economy of time effected in the operation of blooming. It accomplishes five revolutions per minute, and turns out one bloom in each revolution, which is at the rate of 12 seconds for each bloom; whereas the time required in the usual process of hammering is from 60 to 80 seconds per bloom, which is thus about six to one in favor of the machine. By this rapidity of the process of blooming by the improved method, the iron is passed through the bar-rolls at considerably greater heat than from the hammer, and is, in consequence, softer and much better worked in that process,—the rolling being performed in the same heat as the blooming.

A valuable consideration is the saving of expense in manufacture. The machine is self-acting, and requires no men to attend the workings; whereas the hammer requires an experienced artisan in all instances, and sometimes two.

In consequence of the increased speed at which the bloom is turned out (being only one-sixth of the time required by the hammer), the machine is capable of working for a much larger number of furnaces, and the puddlers are never liable to be kept waiting for their turns, as is frequently the case where one hammer works for more than eight or ten furnaces. On the contrary, with the machine, the greatest number of furnaces that can be placed in proximity thereto will not be sufficient to employ it, on the average, more than one-quarter of its time; and, therefore, a very great margin is afforded for meeting the unavoidable irregularities in the supply of the balls from the several puddlers,—thus preventing the waste and deterioration of the iron from being detained in the furnace until the hammer is at liberty.

The expense in tools is very considerable where hammers are used, and is much greater than with the machine. In consequence of the hot iron being five or six times longer in contact with the hammer and anvil than with the machine, and the hot cinder out of the iron lying upon the anvil, instead of falling off constantly as it does in the machine, likewise from the impossibility of applying a constant stream of cold water to the hammer, as is done in the machine,—the hammer and anvil get so very hot where a number of furnaces are working, that they wear out very rapidly, sometimes lasting only a week. They are always liable to break, as is the helve also; and in casualties of this kind the loss is always great.

The expense of keeping the machine in repair is very inconsiderable. The small amount of friction in its action and the slowness of its motion prevent any but moderate and trifling wear of the machine; and the maximum power employed in driving not being greater than that for the hammer, the liability to breakage is considerably less: that is, if the several parts of the machine are put properly to work. The machine at the writer's works (the only one at present in operation) has continued in constant work since it has been erected—about six months—with scarcely any outlays for repairs, except some incurred at starting, through defective construction of some parts of the apparatus; and the writer is of opinion that the cost of wear and tear will not exceed £20 to £30 per annum,—whilst the expense of keeping in repair one hammer, to do half the work of one machine, would be more than ten times that amount.

The saving of power with the machine is next to be noted. The power given out by the engine is only exerted by this machine during one-sixth of the time required by the hammer to do the same work; and during the greater portion of that time the power required in the machine is comparatively small, from the very soft and loose state of the ball; and the full power is not exerted until the revolution is nearly completed. Whereas, with the hammer, the power absorbed is equal throughout the whole of the operation; as the same mass of helve is upheaved at each stroke of the hammer. Less power also is required in rolling the iron from the machine, owing to its greater heat and softness.

For the purpose of ascertaining the actual power expended in working the machine, as compared with the hammer, a series of experiments was entered into, and indicator diagrams were taken from the steam-engine employed to drive both the machine and the hammer, as well as the forge-rolls: these indicator diagrams were taken by Mr. C. W. Siemens, who kindly undertook to try the experiments with Mr. Marshall. During these experiments the engine was kept working at a uniform rate of 20 to 21 strokes per minute; all the other machinery driven by the engine was kept out of use; and the engine was driving the same train of shafting and gearing in all the experiments, making a constant addition to the power exerted in each case.

The result expressed by the indicator diagrams was, that the mean power actually expended in driving the machine averaged 0.84 lbs. pressure per square inch, or 8¾-horse power; whereas the mean power expended in driving the hammer averaged 2.40 lbs. pressure per square inch, or 24¾-horse power. But the machine completed each bloom in 12 seconds, whilst the hammer took from 60 to 80 seconds for the same process. Consequently, the comparison of the total power is 105 (8¾ × 12), to 1732 (24¾ × 70), being a proportion of 1 to 16½ in favor of the machine,—shewing the power required to work the hammer to be 16½ times as great as that required to do the same amount of work with the machine.

A similar comparison was also made between the machine and the hammer, when each was worked in combination with the forge-rolls, as is the case in ordinary working.

A series of five indicator diagrams was taken during the working of the machine and forge-rolls combined, with a continuous succession of ten balls passed directly from the machine through the rolls: the rolls could not, however, work fast enough for the supply of blooms from the machine, although three blooms were in the rolls at once; as the one machine would be capable of keeping up a constant supply of blooms for three pair of rolls.

A corresponding series of five indicator diagrams was also taken during the working of the hammer and forge-rolls combined, whilst one bloom was under the hammer and the previous one was in the rolls. These diagrams shewed the highest pressure exerted during the operation; as the indicator dropped again to the lowest line, in each instance, after the completion of the highest line. In this case, the indicator diagrams shewed that the mean power expended in driving the machine and rolls averaged 7·13 lbs. pressure per square inch, or 64-horse power; and that the mean power expended in driving the hammer and rolls averaged 9·43 lbs. pressure per square inch, or 84¾-horse power.

The comparison of these results cannot be made in the same manner as the former results, from the machine and the hammer alone; as the time of each process of rolling was different from both of them (being about 40 seconds), and the iron from the machine could not be rolled so fast as it was bloomed; but it may be observed that the total increase of power exerted to drive the rolls was actually less in the case of the machine than in that of the hammer, although there were three bars in the rolls at the same moment with the machine, but only one bar at a time with the hammer,—shewing the great saving in the power required to roll the iron from the machine as compared with that from the hammer, in consequence of its much hotter state when brought to the rolls.

Mr. Beasley said he had made some further experiments as to the strength of the iron manufactured by this process, as requested at the last meeting; and although they had been but few, they would be considered, he thought, quite satisfactory. Four bars, 1⅛-inch diameter, had been made in the same manner, and from the same iron, from the hammer as from the machine,—both being made out of the same heat of the furnace. They were tested by Mr. H. Parkes' hydraulic press, at Tipton, for proving chain cables; and the first bar from the machine indicated a strain of 26⅛ tons before it broke. The first bar made by the hammer bore 27⅛ tons; the second from the machine, 26 tons; and the second from the hammer, 25⅛ tons. He then tested two bars, 1⅛-inch dimeter, which had been piled: that from the machine bore 25⅛ tons, and the one from the hammer also 25⅛ tons. He also tried two bars of 1½-inch diameter, which had been piled: that from the hammer indicated 38 tons, and that from the machine, 40 tons. It appeared, therefore, that there is no material difference in strength between the bars made from the hammer and those from the machine. But, for other descriptiuns of iron, he thought the machine much better than the hammer. He exhibited some specimens of hoops, of very tough quality, and also specimens of other descriptions of iron, all bloomed by the machine.

A model of the machine was exhibited;—also a sectional model, in which the operation was shewn by a ball of putty.

The Chairman inquired whether Mr. Beasley had ascertained the relative cost of the two different processes of manufacture.

Mr. Beasley said he had not gone minutely into the matter; but it was known to every iron manufacturer that the expense of the hammer is very considerable,—the wear and tear, and the breakage of tools and helves, amounting to an expense of at least 1*s*. per ton. He found the machine saved, in wages, about 15*d*. per ton, besides the saving in power and in repairs; but, in larger works, the saving would be proportionately greater. Where there were a great many furnaces to keep the machine regularly at work, the saving would be very considerable; but he had not a sufficient number of furnaces adjoining the machine to keep it fully at work.

Mr. Blackwell had seen the machine in operation, and was convinced of its advantages. There was no doubt in his mind that the cinder is more perfectly extracted from the bloom by the machine than by the hammer; and he thought there was no doubt that the quality of the iron was better. He quite agreed with Mr. Beasley as to the saving in the cost of manufacture.

Mr. Adams had also seen this machine at work, and was satisfied as to its efficiency; and he believed the bloom was as good as that produced by the hammer. But he found the cinder still exuded in considerable quantity from the two ends of the bloom, when it received an end blow under the hammer; and he thought a better quality than the ordinary iron from the hammer would be obtained by putting the bloom under the hammer immediately after it comes from the machine, to expel the remaining cinder.

Mr. Beasley thought that, in the case referred to, the ball must have been below the proper limit of size, and, consequently, not fully worked in the machine; which would account for some cinder remaining. A variation of about 20 lbs. was allowed from the standard weight of each ball (about 90 lbs.), which was found quite sufficient with good puddlers, and was allowed for by the yielding of the weight on the screws of the machine, The cinder was still in so hot a state, after coming from the machine, as to be squeezed out by the rolls, and the greatest possible quantity of cinder was taken out by the rolls; so that, in fact, they effected what would be done by using the hammer in addition to the machine.

Mr. Blackwell thought the rolls squeezed out any remaining cinder; and remarked, as a test of the superior action of the machine in separating the cinder, that the yield under the machine is less than under the hammer;—the weight of iron produced of course depending upon the quantity of cinder squeezed out.

Mr. Adams did not mean that the machine did not do the work as efficiently and turn out as good a bloom as the hammer; but he thought that with the addition of the hammer a still better quality of iron might be advantageously produced than was at present manufactured, instead of reducing the expense.

Mr. Beasley exhibited specimens of blooms, of the ordinary make, from the machine and the hammer. He had had a considerable number of them sawn through and polished; and had not detected any flaw in those from the machine. He thought they were at least as free from cinder as those made under the hammering process, and that no cinder remained in the body of the iron. Under the hammer a lap was sometimes formed, by one of the edges of the square bloom being turned over, which is injurious to the iron, as it makes an unsound place or a hollow, in which some of the cinder is lodged, and cannot be driven out afterwards.

Mr. Cowper illustrated, by a model, the mode in which the iron is kneaded by the action of the three rolls, and the cinder squeezed out from the whole of the mass. He said that he had observed the working of the machine, and was satisfied that the cinder was thoroughly squeezed out from the body of the iron. The hammer often chilled the surface of the bloom, which, to a certain extent, enclosed the cinder; but in the machine the cinder ran out very freely; and when that iron was rolled into bars, the cinder did not squeeze out of the ends, as is the case with the iron bloomed with the hammer,—in fact, so much so, that, in rolling the blooms from the hammer, the men always stand on one side, to get out of the way of the cinder flying out of the ends; but with the blooms from the machine he had never seen any cinder squeezed out from the ends in rolling, or if any it was very trifling indeed, although the iron was in a much hotter state when rolled than that from the hammer

Professor Hodgkinson said he thought the machine was a most ingenious one; but, notwithstanding the good appearance of the iron, he felt a doubt whether it was quite so efficient as the hammer in squeezing out the cinder; but he had not sufficient information to speak from, as he had not seen the working of the machine. The appearance of the iron was certainly excellent; and there was great ingenuity shewn in the machine.

Mr. Beasley wished to make one other remark relative to the heat of the bloom as it comes from the machine. He thought it was possible to make a good weld, under the hammer, of two of the blooms from the machine; he therefore worked two balls in rapid succession, and brought them to the hammer; when as good a weld was made as if the iron had been brought direct from the furnace. He believed iron manufactured in that way would save a great deal of expense in making rails; and the iron could be rolled at once without a second heating of the metal

The Chairman observed that it was important that there should be a comparative test made of the quality of the iron, as prepared by the machine, and that by the ordinary process of the hammer; and he suggested to Mr. Beasley to make a piece of iron, as well as he could, under his process; and to get another manufacturer to make a similar piece under the old process of hammering: the two specimens might be then submitted to Professor Hodgkinson for examination of their comparative merits.

Mr. Beasley said there might be a material difference in the quality of the specimens of iron, independent of the difference in the process of blooming, which would interfere with the results of the experiment. But he should be glad to try the experiment of the two processes, by taking iron from the same furnace, at the same heat; and if one ball was taken to the hammer and another to the machine alternately, and then the iron of each tested, he thought that would be a fair trial. He would be ready to go through a series of experiments for the purpose.

Mr. Scott Russell remarked, that even if Mr. Beasley made no better iron by his machine than had been done heretofore by the hammer, he thought he had done a great deal in bringing the iron to a state to undergo the subsequent processes by more economical means.

Captain W. S. Moorsom hoped the experiment would also be tried that had been suggested, of obtaining an improved quality of iron by the subsequent process of hammering, in addition to the action of the machine, so that a material of greater strength might be obtained if possible.

Mr. Beasley said he would be glad to go into that matter; undoubtedly the iron might be improved for some purposes by subsequent hammering, as suggested; but, for general purposes, he thought it would be useless, and an extra expense without any corresponding advantage.

The Chairman proposed that any gentlemen who felt interested in the subject should communicate with the secretary, and arrange the further experiments to be conducted at Mr. Beasley's works, and bring the results before the Institution.

New Patents

SEALED IN ENGLAND.

1851.

To Peter Robert Drummond, of Perth, for improvements in churns. Sealed 29th July—6 months for inrolment.

Charles Barlow, of Chancery-lane, London, Esq., for improvements in saws,—being a communication. Sealed 31st July—6 months for inrolment.

John Workman, of Stamford Hill, in the county of Middlesex, fumist and furnace builder, for improvements in the manufacture of bricks, tiles, and other articles made of like materials. Sealed 31st July—6 months for inrolment.

Victor Lemoign, of Cette Department de l'Herault, France, for certain improvements in rotary and other engines. Sealed 31st July—6 months for inrolment.

Charles Cowper, of Southampton Buildings, Chancery-lane, for improvements in locomotive engines and boilers, and carriages, part of which improvements are applicable to other similar purposes,—being a communication. Sealed 31st July—6 mos. for inrolment.

James Whitelaw, of Johnstone, in the county of Renfrew, N.B., engineer, for certain improvements in steam-engines. Sealed 31st July—6 months for inrolment.

Joseph Mansell, of Red Lion-square, in the county of Middlesex, manufacturing fancy stationer, for improvements in ornamenting paper and other fabrics. Sealed 31st July—6 months for inrolment.

Charles Perley, of the City of New York, in the United States of America, machinist, for certain new and useful improvements in the construction of capstans for nautical and general purposes. Sealed 31st July—6 months for inrolment.

Edward de Mornay, of Mark-lane, in the City of London, Gent., for improvements in machinery for crushing sugar-canes, and in apparatus for evaporating saccharine fluids. Sealed 5th August—6 months for inrolment.

Levi Bissell, of the City, County, and State of New York, engineer, for certain new and useful improvements in the means of sustaining travelling carriages, and other vehicles, which improvements are applicable to other like purposes. Sealed 5th August 6 months for inrolment.

Edwin Deeley and Richard Mountford Deeley, of Andnam Bank, in the county of Stafford, flint and bottle-glass manufacturers, for certain improvements in the construction of furnaces for for the manufacture of glass. Sealed 6th August—6 months for inrolment.

Robert Hyde Greg, of Manchester, manufacturer, and David Bowlas, of Reddish, in the county of Lancaster, manufacturer, for certain improvements in machinery or apparatus for manufacturing weavers' healds or harness,—being a communication. Sealed 7th August—6 months for inrolment.

Lockington St. Lawrence Bunn, of Walbrook, in the City of London, merchant, for improvements in the manufacture of kamptulicon. Sealed 7th August—6 months for inrolment.

Alphonse Réné le Mire de Normandy, of Judd-street, in the county of Middlesex, Gent., and Richard Fell, of the City-road, in the same county, engineer, for improved methods of obtaining fresh water from salt water, and of concentrating sulphuric acid. Sealed 7th August—6 months for inrolment.

Jonathan Grindrod, of Birkenhead, in the county of Chester, consulting engineer, for an improvement in the machinery for communicating motion from steam-engines or other motive power, and in the construction of rudders for vessels. Sealed 14th August—6 months for inrolment.

Aimé Nicolas Derode, of Rue St. Roche, Paris, France, Gent., for a certain process for uniting cast-iron to cast-iron and other metals, and for uniting other metals together. Sealed 14th August—6 months for inrolment.

Henry Glynn, of Bruton-street, Berkeley-square, Gent., and Rudolph Appel, of Gerrard-street, Soho, anastatic printer, for improvements in the manufacture or treatment of paper or fabrics, to prevent copies or impressions being taken of any writing or printing thereon. Sealed 14th August—6 months for inrolment.

Thomas Skinner, of Sheffield, for improvements in producing ornamental surfaces on metal and other materials. Sealed 14th August—6 months for inrolment.

John Plant, of Beswick, Manchester, manufacturer, for certain improvements in the manufacture of textile fabrics. Sealed 14th August—6 months for inrolment.

Joseph Birkbeck Blundell, of New Cross-road, in the county of Kent, Gent., for improvements in machines for sweeping and cleansing roads and ways. Sealed 14th August—6 months for inrolment.

Stephen Moulton, of Bradford, in the county of Wilts, India-rubber manufacturer, for certain improvements in the preparation of gutta-percha and caoutchouc; and in the application thereof. Sealed 14th August—6 months for inrolment.

Lot Faulkner, of Cheadle, in the county of Chester, machinist, for certain improvements in the method of obtaining and applying motive power. Sealed 21st August—6 months for inrolment.

James Roberton, of Oxford-street, in the city of Manchester, chemist, for improved methods of producing or obtaining printing dyes, and other substances used in printing; which improvements, in whole or in part, are applicable to other like useful purposes. Sealed 21st August—6 months for inrolment.

John Waters, of Sheffield, manufacturer, for certain improvements in knives and forks. Sealed 21st August—6 months for inrolment.

John Treasahar Jeffree, of Blackwall, in the county of Middlesex, engineer, for an improved apparatus for facilitating the more perfect combustion of fuel; whereby funnels in steam vessels, and chimnies or shafts for factories, may be dispensed with. Sealed 21st August—6 months for inrolment.

James Palmer, of Paddington, in the county of Middlesex, artist, for improvements in delineating objects; and in apparatus and materials for that purpose. Sealed 23rd August—6 months for inrolment.

Edward Clarence Shepard, of Duke-street, in the City of Westminster, Gent., for improvements in obtaining and applying motive power,—being a communication. Sealed 28th August—6 months for inrolment.

Thomas Brown Jordan, of Lambeth, in the county of Surrey, engineer, for improvements in machinery or apparatus for cutting, dressing, planing, and otherwise working slate; and also for framing and setting the same. Sealed 28th August—6 months for inrolment.

James Edward Mc Connell, of Wolverton, in the county of Buckingham, engineer, for certain improvements in locomotive steam-engines and railway axles; parts of which are applicable to stationary and marine steam-engines. Sealed 28th August—6 months for inrolment.

William Johnson, of Millbank, in the City of Westminster, Gent., for improvements in ascertaining the weight of goods. Sealed 28th August—6 months for inrolment.

CELESTIAL PHENOMENA FOR SEPTEMBER, 1851.

D.	H.	M.	
1			Clock after the ☉ 0m. 0s.
—			☽ rises 0h. 15m. A.
—			☽ pass mer. 5h. 5m. A.
—			☽ sets 9h. 47m. A.
2			♂ in conj. with Ceres, diff. of dec. 1. 42. N.
4			Occul. 23 Sagittarii, im. 8h. 29m. em. 9h. 50m.
—			Occul. 30 Sagittarii, im. 11h. 18m. em. 12h. 14m.
5			Clock after the ☉ 1m. 17s.
—			☽ rises 4h. 26m. A.
—			☽ pass mer. 8h. 33m. A.
—			☽ sets Morn.
7	20	43	Juno in □ with the ☉
8	8	28	☿ stationary
9			Occul. 74 Aquarii, im. 6h. 27m. em. 7h. 23m.
10	1	44	Ecliptic oppo. or ○ full moon
	4		☽ in Apogee
11	13	53	☿ greatest hel. lat. S.
13	20	25	♅ in conj. with the ☽ diff. of dec. 4. 47. N.
	21	22	♄ in conj. with the ☽ diff. of dec. 2. 29. N.
14			Mercury, R. A., 12h. 14m. dec. 6. 3. S.
—			Venus, R. A., 11h. 13m. dec. 6. 30. N.
—			Mars, R. A., 6h. 40m. dec. 23. 30. N.
—			Vesta, R. A., 17h. 23m. dec. 24. 0. S.
—			Juno, R. A., 17h. 5m. dec. 9. 48. S.
—			Pallas, R. A., 3h. 42m. dec. 10. 53. S.
—			Ceres, R. A., 6h. 24m. dec. 22. 12. N.
—			Jupiter, R. A., 13h. 31m. dec. 8. 22. S.
—			Saturn, R. A., 2h. 9m. dec. 10. 11. N.
—			Uranus, R. A., 2h. 7m. dec. 12. 20. N.
—			Mercury pass mer. 0h. 43m.
14			Venus pass mer. 23h. 42m.
—			Mars pass mer. 19h. 7m.
—			Jupiter pass mer. 2h. 0m.
—			Saturn pass mer. 14h. 35m.
—			Uranus pass mer. 14h. 33m.
—			Occul. B.A.C. 845, im. 10h. 20m. em. 11h. 16m.
15			Vesta in □ with the ☉
—			Clock after the ☉ 4m. 43s.
—			☽ rises 8h. 10m. A.
—			☽ pass mer. 2h. 26m. M.
—			☽ sets 9h. 16m. M.
16			Occul. 63 Tauri, im. 10h. 20m. em. 11h. 15m.
	17	23	♀ greatest hel. lat. N.
18	1	29	☽ in □ or first quarter
19	8	53	♂ in conj. with the ☽ diff. of dec. 1. 32. N.
20			Clock after the ☉ 6m. 29s.
—			☽ rises Morn.
—			☽ pass mer. 7h. 26m. M.
—			☽ sets 3h. 39m. A.
21	18	19	☿ in inf. conj. with the ☉
	21	51	☿ in conj. with ♀ diff. of dec. 4. 34. S.
23	3	51	☉ enters Libra,—Autumn com.
24	5	15	☿ in conj. with the ☽ diff. of dec. 7. 0. S.
	10		☽ in Perigee
	13	32	♀ in conj. with the ☽ diff. of dec 3. 28. S.
25			Clock after the ☉ 8m. 12s.
—			☽ rises 5h. 42m. M.
—			☽ pass mer. 0h. 13m. A.
—			☽ sets 6h. 27m. A.
	6	12	Ecliptic conj. or ● new moon
26	7	41	♃ in conj. with the ☽ diff. of dec. 4. 17. S.
29	19	55	♀ in sup. conj. with the ☉
30			Clock after the ☉ 9m. 52s.
—			☽ rises 0h. 25m. A.
—			☽ pass mer. 4h. 43m. A.
—			☽ sets 8h. 56m. A.
	2	15	☿ stationary
	13	33	☿ in the ascending node

Eclipses of Jupiter's Satellites are not visible this month.

J. LEWTHWAITE, Rotherhithe.

THE
LONDON JOURNAL,
AND
REPERTORY
OF
Arts, Sciences, and Manufactures.

CONJOINED SERIES.

No. CCXXXVIII.

THE INDUSTRIAL EXHIBITION.

GENERAL REMARKS.

The near approach of the period for closing the Great Exhibition, and once more dispersing over the face of the earth the countless and rare specimens of man's ingenuity and Nature's prodigality, which have been, with infinite labor, collected together, would seem to admonish us of the propriety of bringing our series of papers on the *Industrial Exhibition* to a close; but we think that, by immediately adopting this course, we should, besides acting very indifferently up to our promises, lay ourselves open to the charge of having prematurely abandoned a plan, which must, if persevered in, have told very advantageously upon the manufactures of Great Britain. Without arrogating to ourselves a power equal to effecting the sudden demolition of long-established prejudices, and the rapid enlightenment of ignorant and thoughtless minds, we have full and sufficient proof, that our labors have not been without effect in calling attention to unobtrusive merit, and discovering defects where perfection was supposed to have existed. As, therefore, this field of inquiry, in connection with the Exhibition, is far from exhausted, we propose, for the present, to continue these papers, and render as complete as possible our review of those branches of industry which have already been noticed in this Journal; and likewise to take up such new matters of interest as our notes will, after the closing of the Exhibition, enable us to treat of in a satisfactory manner.

In the present number, under the head *Agricultural Implements*, we complete an analytical examination of ploughs, describing the construction of all those implements which, either from the peculiarities they possess, or the advantages they displayed at the trial before the jurors, seem to point them out as worthy of particular remark. This copious review will, we believe, be specially acceptable to our agricultural friends, from being the only intelligible record of what modern ingenuity has done for the most important implement used in agriculture.

Following our remarks of last month, on the specimens of sand contained in the *Raw Materials* department, we are now led to an examination of the manufacture of glass. The position of this branch of industry in Great Britain (after making all due allowances for its necessarily infantile condition while burdened with that great incubus the Excise) is, we are constrained to say, far from satisfactory, when compared with the productions of France. Such being the case, more especially in the matter of plate-glass, the defects of which are ascertainable by the most unpractised eye, we have felt it desirable to enter somewhat at length into the cause of our inferiority, and to urge upon glass manufacturers generally the adoption, for the improvement of their manufacture, of the only means which will ensure a uniformly favorable result. If, in our strictures, we may seem to have spoken with unnecessary severity, it should be remembered that we have stubborn ignorance to contend against, if not in all, at least in many of our glass-houses; and further, that of all manufactures, this is the one which has been most petted and praised for its rapid advancement,—the credit of which is almost wholly due to the skilful manipulation of the workman. In other respects, it has but little if at all advanced since its release from the supervision of the Excise, and is as much in subjection to the "rule of thumb" as the British pottery manufactures which came under our censure on a former occasion.

Our present notice of *Labor-Saving Machines* completes our review of that interesting, but, as we think, very inefficiently represented branch of ingenuity.

Decorative Art still continues to furnish ample materials for comment; and considering that an active desire for the advancement of this much-neglected pursuit was the impelling power which set afloat the scheme for an international exhibition, it is but fair that, amongst other subjects of a more practical tendency, which might, perhaps, justly claim precedence, decoration should not be overlooked; and we are the more anxious that this subject should be thoroughly examined, as, in the absence of the critic, the Exhibition, from the numerous examples it presents of incongruous design and slavish imitation, may have rather a tendency to debase than to raise the art of the designer.

AGRICULTURAL IMPLEMENTS.

In our last number, after classifying, according to their uses, the various kinds of ploughs contained in the Exhibition, we proceeded to comment on the several "swing and wheel ploughs" which seemed, from their peculiarities of construction, to deserve notice. We shall now continue our notice of the remaining ploughs embraced by the first class, and then take up the other classes, in the order indicated in the preceding paper. It may, however, be well first to direct attention to a single-furrow plough of Messrs. Talbot, of Menneton Salon, near Bourges, France, which had previously escaped notice, owing to its being detached from the collection of French ploughs. This is a difficulty which we have had frequently to encounter; and it is one which the official catalogues serve rather to increase than diminish, from the fact, that many articles are noted which the Exhibition does not contain, while others are to be found that have no place in the catalogues.

To the French plough, above named, a prize medal has been awarded. It has a wooden beam and handles; and the mould-board, share, and coulter, are of the ordinary description. The beam is inclined, and supported, at the fore end, by an iron frame or carriage, mounted on a pair of large wheels; and the distance of the carriage from the plough-body, and consequently the height at which the end of the beam is supported, is regulated by means of the draught-chain. The fore end of the draught-chain is secured to a hook, affixed to the axle of the carriage; at about the middle of the chain is a link, which embraces the beam, and is secured to a straight iron bar, that rests on the top of the beam, and is capable of sliding thereon; and from this bar the remaining portion of the chain extends backwards, and terminates in a link, which connects it with a traverse-nut on a stationary screw-rod: on this rod being turned, the nut will, through the medium of the draught-chain, draw back the carriage, and thereby elevate the beam.

TURN-WREST PLOUGHS.

"One-way," "turn-over," or "turn-wrest" ploughs, are intended to lay the furrows in one and the same direction. The earliest construction we believe to be the Kentish turn-wrest plough, which lays the furrow-slice quite flat, without any opening in the seam, and is well adapted for stiff soils. It is a four-horse plough; but for those who require a plough that may be worked with a pair of horses, the Kent plough of Messrs. Ransomes and May, and Messrs. Howard's JK plough, have been introduced, and fitted with mould-boards which give a similar turn of furrow.

Of this class of ploughs the Exhibition contains several varieties. Messrs. Wilkie & Co. shew one made wholly of malleable iron. To the top face of the beam is hinged a frame (composed of a couple of bars), which carries two shares and two mould-boards,—one share and mould-board being suitable for turning a furrow to the right, and the other share and mould-board for turning one to the left. The frame stands in a vertical position at one or other side of the beam when the plough is at work; and the shares and mould-boards are so mounted that, when the right-hand ones are working in the soil, the left-hand share and mould-board will stand directly over them in an inverted position, and *vice versâ*. When it is desired to turn the furrow in the opposite direction, the frame is caused to turn over on its axis to the other side of the beam, so as to bring the left-hand share and mould-board into action. Messrs. Gray and Sons, of Uddingston, also exhibit one of this kind of ploughs; and Mr. R. Law, of Shettleston, Glasgow, has a model of one of the same construction.

Mr. J. Comins, of South Molton, exhibits two turn-wrest ploughs, which differ only from each other in these respects, that in one the beam and handles are of wood, while in the other they are of iron; and the plough with the wooden beam is fitted with a double skim coulter. This construction of plough is furnished with two mould-boards, fastened together at the front,—thus Λ; and the double mould-board is connected at the fore-end to the front bar of the plough-body, and is capable of turning on the same as a centre, to admit of its being moved to the right or left-hand, in order to bring one or other of the mould-boards into action. When the right is brought into use, the left one will come against the side of the plough-body, and serve as the land-side plate; and *vice versâ*. Each time that the mould-board is shifted, the share, which is formed with one wing or fin, is turned over to the corresponding side. To effect this, the share is fixed to the end of a rod, having, at its hind end, a small toothed wheel or pinion in gear with the teeth of a rack-bar, which is fastened at each end to the inner sides of the mould-boards, and serves to connect the hinder parts of the same together: hence it follows, that, if the rod be caused to turn, not only will the share be turned over, but, by means of the pinion and rack-bar, the double mould-board will be simultaneously shifted. The requisite motion is imparted to the rod by raising a lever, which is connected, by a small rod, with a short crank on the end of the first-named rod. When the plough is fitted with the double skim coulter, it is requisite to turn the latter partly round when the double mould-board is shifted: this is effected by pulling a rod which is connected to a small crank on the top of the coulter stem.

Mr. H. Lowcock, of St. Peter's-street, Tiverton, exhibits a turn-wrest plough, which presents the appearance of two ploughs, united at the heel of the beam or back part of each plough,—the object being, to plough in opposite directions without turning the implement at the end of the furrow. The beam, which is affixed to the frame or body at the centre of its length, is provided with a small guide-wheel near each end, and also carries two coulters, pointing in opposite directions. The handles are straight, and are connected to the middle of the beam by a centre-pin, which admits of their being turned over towards either end of the beam. The handles are provided with a hanging spring-catch, which drops into an opening near the end of the beam, and thereby secures them in their required position. To one side of the beam a horizontal rod is affixed, extending from end to end, and carrying the draught-link or ring, which can readily shift from one end of the beam to the other by sliding along the rod. The mould-board is a plate of iron, in appearance somewhat like two common mould-boards, a right and a left one, united together back to back; and at the centre thereof is a recess, in which is pivotted the fore end of a piece of iron, resembling the tail-pieces of two mould-boards, fixed together side by side: so that, when such tail-piece is turned in one direction, it will form the hind end or continuation of the right mould-board; and, when turned in the opposite direction, it will form the hind end of the other. There are two shares of the common form, affixed to the body of the plough at either end. To reduce the friction, the sole of the plough is slightly inclined upwards from the centre towards each end, so that the plough will only rest upon the part of the sole between the centre thereof and the share which, for the time being, is in action; and, for the like purpose, the land-side is formed with two inclined planes, extending from the centre to the ends. When using this kind of plough, the ploughman, on the completion of a furrow, turns over the handles to the opposite end of the beam, and brings round the horses on the land-side of the plough,—the draught-ring sliding along the rod to the other end. As soon as the horses begin to draw again, the tail-piece of the mould-board comes in contact with the newly-cut furrow-slice, and moves upon its pivots into the proper position for turning over the same.

M. J. Gisin, of Liestal, Bâle, Switzerland, exhibits a turnwrest plough, which, like the preceding, has a mould-board with a swinging or vibrating tail-piece at the centre, and a share at each end; but, in this case, the beam, instead of being a fixture, moves round upon an axis at the centre, when it is desired to reverse the action of the plough. The beam is supported at the centre by a gallows-shaped frame, the upright bar of which has a pivot at each end,—the upper one turning in a hole in a bar affixed to the top of the mould-board, and the lower one in a bearing at the junction of the sole and land-side plates. The inclined bar of the gallows-frame comes against the inner side of that end of the mould-board which is at the time in action, and an iron trigger-bar, jointed to the beam, bears against the other end of the mould-board; and thus the beam is firmly held in the desired position. At the fore end of the beam is a small guide-wheel; and at the hind end it is furnished with a pair of fixed handles. For the purpose of adjustment, the fore part of the beam is jointed to the hind part; and at the joint a continuation of the fore part stands up at right angles,—which, being fitted with a swivel-nut, that works upon an inclined screw-bolt, affixed to the hind end of the beam, allows of the angle of inclination of the fore end of the beam being changed, and, consequently, of the adjustment of the guide-wheel. When a furrow is completed, the trigger, above mentioned, is raised, and the horses moving round upon the land-side of the plough reverse the beam, which is then again fixed by the trigger, and the plough is ready to commence a fresh furrow.

M. Pardoux, of Randon, Puy-de-Dôme, France, exhibits an iron turn-wrest plough, of somewhat similar construction to that of Messrs. Wilkie,—one share and mould-board, when in a working position, having a share and mould-board inverted above them: in this case, however, the two mould-boards form one continuous curved surface. The frame that carries the mould-boards and shares is hinged to the under side of the beam, and turns beneath it, when it is required to reverse the plough. A short bar, with two bent or hooked pieces at the sides thereof, is pivotted to the beam; and the frame is fixed in the desired position by raising the bar, and thereby causing one or other of its hooked pieces to embrace that side-bar of the frame which is uppermost. The fore end of the beam, which is bent downwards at right angles, is connected, by a rod, with the body thereof, in advance of the coulter, and by another rod with the drag-link, to which the horses are yoked; at the bend in the beam two arms are affixed, one on each side, to support the stems of the bars that carry the pivots of two large fore-wheels; and the hind end of the beam terminates in a short straight handle.

M. Pardoux likewise exhibits another turn-wrest plough, closely resembling the preceding, but of lighter construction. It has only one wheel, which runs beneath the beam, near the fore end, and within a looped portion of the draught-rod, which carries the axle of the wheel. This rod is hinged at one end to the beam, just before the coulter; and the other end, to which the drag-chain is connected, is carried by an upright adjustable rod, attached to the beam.

In the American department, Messrs. Starbuck and Son, of Troy, contribute a turn-wrest plough, the mould-board of which is an iron plate, nearly flat or but slightly curved, with a two-winged share, forming a continuation thereof. The mould-board and share are affixed to a curved iron frame, that turns on a horizontal axis in the sole; and they are retained in the desired position by means of a hooked rod, which is suspended from the framing of the plough-handles, and catches into a hole in the mould-board, near that edge which is uppermost.

A turn-wrest plough, of like construction, is also exhibited by Messrs. Allen and Co., of New York.

M. Verbist, of Nivelles, Belgium, shews an implement of this kind with an arrow-shaped or two-winged share, of which the mould-board is a continuation,—the edges thereof being turned back at the hind end. The mould-board and share are connected to a horizontal pin or axis in the sole, so as to admit of changing to opposite sides; and they are retained in the desired position by causing a small bar to project downwards on one side or the other (as the case may be) of that wing of the share which is uppermost: this bar moves between two fixed bars, and is connected at the top to a lever, whereby it is raised or lowered.

M. Van Macle, of Thielt, West Flanders, exhibits a turn-wrest plough, which has two shares, mould-boards, and coulters, affixed to the same frame, one set above the other, in an inverted position, as in Messrs. Wilkie's plough. The after part of the beam extends horizontally over the plough-frame, and a descending piece at each end of such horizontal portion carries the axis of the plough-frame. From the lower end of the foremost descending piece the beam continues in a horizontal line to its fore end, to which is connected the draught apparatus and a guide-wheel that travels beneath the central line of the beam. The hindmost descending portion of the beam is provided with a handle, and carries a catch, whereby the plough-frame is fixed in a vertical position; and, for this purpose, there is also provided a hand-screw, which passes vertically through the beam and enters one of the side bars of the frame.

TWO OR MORE FURROW PLOUGHS.

The double-furrow plough, as its name implies, consists of two ploughs having one beam in common, or else (as is most generally the case) having two beams, which are firmly secured together, and connected to a single pair of handles. The ploughs are fixed, at a suitable distance apart, one in advance of the other, so as not to interfere with the proper turning of the furrow-slice. The double-furrow plough is intended for light soils, and will in general accomplish as much work, with the aid of a man and three horses, as could be performed in the same time by two single ploughs, with a man and two horses to each.

Implements of this kind are exhibited by Messrs. Ransomes and May, and Messrs. T. & F. Howard, in the British department, and by M. Delstanche in the Belgian department; but they present no points for comment.

Messrs. Allen & Co., of New York, have a plough with three small shares and mould-boards, attached to a cross-beam, which is fixed diagonally beneath the ordinary plough-beam. This plough is used in the United States for ploughing in wheat, rye, and other grain, after sowing; and as it turns over three furrow-slices at the same time, it will plough from three to five acres per day.

Under this class may be included Lord Willoughby De Eresby's steam ploughing apparatus, designed to plough land having a moderately even surface. The machinery consists, firstly, of a locomotive steam-engine, of 26 horse-power, weighing 3½ tons, and fitted with a double capstan-barrel, which can be removed when the engine is required for other uses. The engine moves across the centre of the field upon a light railway—progressing a short distance at intervals, as hereafter mentioned. There are two sets of ploughs, which advance and recede on either side of the railway, at right angles thereto. Each set consists of four ordinary ploughs, and the like number of sub-soil ploughs (one behind each common plough), fixed in a frame, provided with two pairs of running wheels and several guide-wheels. Each frame carries a small platform, on which a man stands, to direct the same. The two plough-frames advance and recede alternately; as they advance, the soil is ploughed up, but on receding, the ploughs are inoperative. When the furrows on either side of the railway are completed, the engine advances about three feet, and the plough-frames are shifted laterally to the same extent. Each plough-frame is attached to an endless chain, about 150 yards long, which passes around one of the capstan-barrels of the engine, and around a pulley, fixed temporarily at the side of the field; and thereby the desired motion is given to the ploughs.

Mr. J. Usher, of Edinburgh, exhibits a model of a locomotive steam-plough. The engine is supported by four wheels, which travel upon the land to be ploughed; and to the axle of the fore-wheels a swivel-frame is connected, which admits of the machine turning readily in a small space. At the back of the machine is a horizontal shaft, which carries five iron plates or discs. Each disc is provided with three curved projections or arms (equidistant from each other), to receive a curved plough-share;—thus forming a rotating plough, the shares of which stand in the same plane around the shaft. The ploughs are so arranged that two shares will never strike the earth at the same instant. When the power of the engine is applied to the shaft, the several ploughs will penetrate the soil, and the resistance which is offered by the earth will cause the machine to move onwards across the field.

MOULDING AND UNIVERSAL PLOUGHS.

The implements embraced by this division are "moulding or double-tom ploughs," "drill-ploughs," "ridge-ploughs," and "universal ploughs." These ploughs have two mouldboards or breasts, one on each side of the body (on which account they have also been called "double-breast ploughs"),—their action being, to turn the soil to the right and left simultaneously, and thereby to throw up the earth into continuous ridges, and form channels or open furrows. The beams and handles are like those of the common ploughs; the shares are, in general, either two-winged or chisel-shaped; and they work without coulters. There use is to open drills and form ridges or "bouts" for potatoes, turnips, and other root-crops (whence they have likewise been termed "bouting ploughs"), to set out lands for common ploughing, open surface-drains or water-furrows, and mould or earth-up root-crops, peas, and beans: most of them are also capable of being converted into horse-hoes and broad-share and subsoil ploughs.

It has been the usual practice to form the two mould-boards separately, and either to bolt them to the body behind the throat-piece of the plough, or to connect them to the throat-piece by hinge-joints, so as to admit of their expanding. The joints thus formed at the fore part of the plough, besides being liable to injury, have a tendency to collect the soil and clog the mould-boards. To obviate these disadvantages, Mr. Bentall casts the mould-boards in one piece with the throat of the plough, and makes them so elastic as to admit of their being expanded to the desired extent. This improvement is shewn as applied to a double-tom plough. To the inner face and at the hinder part of each breast, in this implement, a screw-pin is bolted, which projects through an opening in the end of a horizontal bar, affixed to the plough-body; and each screw-pin is provided with two nuts, which, by being screwed up, one on each side of the bar, serve to adjust the relative positions of the sides of the mould-board, which stand nearly vertical, so as to displace and not turn over the soil. The plough-beam is of wrought-iron; and the share, which is a flat piece of metal, having parallel sides, with a chisel-shaped end, forms also the sole-plate of the plough. It is convertible into a horse-hoe or cleaning plough for root-crops, by removing the double mould-board, substituting a small broad-share with a long point in advance thereof (upon the plan hereafter described) for the chisel-shaped share, and fixing across the hinder part of the beam a bar, carrying two bent blades or sharp-edged tines (curving inwards towards each other), for clearing the sides of the ridges of weeds. On removing the curved blades, and substituting a larger broad-share for the small one, it may be used as a skim or paring plough.

Mr. Warren, of Heybridge, exhibits a double-tom plough with a broad chisel-shaped share, and with mould-boards of similar shape to those of the preceding plough, but cast separately, and connected to the throat-piece. In order that the mould-boards may be adjusted to the desired width, a short arm is bolted to the inside of each; and these arms are connected to a bar, affixed to the plough-body, by passing a bolt through a hole in the end of each arm and through a slot in the bar. A bar, with two curved blades, is fixed across the hind end of the beam.

Messrs. Sellar and Son, of Huntly, near Aberdeen, exhibit a "double mould or drill-plough," which gained the first prize of the Royal Northern Agricultural Society in 1850. The share of this plough is formed with a chisel end, and the expanding mould-boards are of a peculiar form,—the front part and the upper portion of the hind part of each mould-board being vertical, and the under surface inclining inwards, forming a tapering incline, which gradually increases from the front to the back. This plough is furnished with a gauge, for regulating the distance of the drills from each other. The gauge consists of a light metal bar, the length of which can be increased or diminished at pleasure; it is pivotted or hinged to the top of the beam, over the body of the plough, in such manner that it will stand out at right angles thereto, in a horizontal direction, on either side; and, at its outer end, it carries a small hanging pointed blade or marker, which swings freely thereon. The use of the marker is to draw a line upon the soil parallel to the furrow or drill which the plough is producing, so as to serve as a guide to the ploughman when forming the next drill; for this purpose, it is retained in nearly a vertical position beneath its bar by a small stay-chain, fastened thereto at one end, and at the other secured to the fore end of the beam; and a similar chain extends from the end of the bar to the plough-handles, to enable the ploughman to lift the bar and marker over to the opposite side of the beam when he has turned the plough to commence a fresh drill.

Mr. Ponton, of Groughfoot, Linlithgow, contributes a drill-plough, to which the first premium of the Highland and Agricultural Society of Scotland was awarded in 1850. It is of similar construction to the preceding one; but the sides of the mould-boards are vertical; and, in place of the gauge-bar having a single moveable marker, a double marker is formed in one piece with the end of the bar (somewhat like the arms of an anchor): the pointed ends of the marker come into action alternately, as the bar is turned over by the ploughman at the commencement of each furrow.

Messrs. W. and J. Ritchie, of Ardee, Ireland, exhibit an iron drill-plough with expanding mould-boards, which are hinged to the throat-piece. To the inner side of each mould-board, near the hind end, a short rod is jointed; the ends of these rods are connected together by a pin, affixed to a nut, which fits upon a screw-shaft; and, on such shaft being turned (by means of a handle at the end), the nut is caused to traverse along it,—whereby, through the medium of the short rods, the adjustment of the mould-boards is effected. The beam is short, and ends in the space between the mould-boards; and there it is connected by a cross-bar to two long flat iron bars, which terminate in handles.

A "double water-furrow roller plough" is exhibited by Mr. Low, of Overgate, Dundee. This implement has a share with a long spike point, and a pair of flat-sided mould-boards, which can be expanded by means of a screw-shaft and nut, as in the plough of Messrs. Ritchie. Behind the mould-boards there is a wooden roller, with a bulge or projecting rib around the centre, to form the water-furrow, and also to press down the sides of the furrow,—making the ridge broad and the water-furrow narrow. The pivots of the roller are carried by two arms, suspended from the handles or stilts, and having a cross-bar, which is connected by a curved rod with a lever: by means of this lever the roller can be raised or lowered; and the lever is fixed in any desired position by inserting a pin through it and through one of a series of holes in an arched plate affixed to the beam.

Mr. J. Stuart, of Aberdeen, has two iron universal ploughs, constructed on the same plan. One is fitted with a long pointed share and double expanding mould-boards, which are flat at the upper part, and bent under or inclined inwards at the bottom; and they are adjusted by means of jointed bars, passing through a clamp affixed to the beam. The other implement is fitted as an ordinary swing plough, with single mould-board, adjusted in like manner. The handles, in each case, are hinged to the sides of the beam; and when the implement is to be used as a moulding or drill plough, they are fixed in positions diverging equally therefrom; but when it is to be converted into a swing plough, the handles are shifted to one side, so that the handle on the land-side will come close to the beam, and, as it were, form a continuation thereof. A land-side plate is of course affixed to the plough-body in place of that mould-board which is removed in order to convert it into a single-breast swing plough. On the mould-board and land-side plate being removed, the implement may be used as a subsoil plough.

Messrs. Barrett, Exall, and Andrews, contribute a universal plough, which may be used with a single mould-board, coulter, and guide-wheel, as an ordinary one-wheel plough; or, with with two mould-boards and a two-winged share, it may be employed as a moulding or earthing-up plough; or, by removing both mould-boards, and fixing across the beam a bar, which carries two hoes, it may be converted into a horse-hoe.

Messrs. Ransomes and May shew their truss-beam (described at p. 207) applied to a moulding or double-tom plough, which has a two-winged share, and double fixed mould-boards: on removing the latter, the implement may be used as a broad-share or a subsoil plough. They also exhibit "Clarke's universal ridge plough," under four phases. This is an iron plough, with a trussed beam. It is first shewn with double mould-boards and a two-winged share: in which state it is to be used as a double-tom or ridge plough. By the substitution of lower mould-boards, it is rendered suitable for moulding or earthing-up root-crops, and peas or beans. It is convertible into a horse-hoe or cleaning plough, by taking off the mould-boards, and affixing to the plough-body a rectangular frame, which carries the stems of two curved coulters or of two flat hoes. It becomes a skeleton or broad-share plough, on this frame being removed, and a broad-share with rising prongs substituted for the two-winged share.

A double-tom or moulding plough, of gigantic dimensions, is also exhibited by the same firm. It is made for the West Indies;—its use being to open cane-holes or mould-up rattoons. This plough has a trussed beam, expanding double mould-boards, and a two-winged share. By removing one of the mould-boards and substituting a single share for the two-winged one, it is converted into a single or furrow plough. It is sometimes fitted with a revolving coulter, having sharp steel edges, for the purpose of cutting the trash and burying it at one operation. Without the coulter, it may be employed as a trench plough.

Messrs. Allen and Co., of New York, furnish a light one-horse plough, with fixed double mould-board, of an easy curvature, and a two-winged share. They also exhibit a large plough of this class, which appears to be specially intended for the cultivation of the sugar-cane. It has flat or upright mould-boards; and the heel of the beam is supported by a small wheel, which travels between the mould-boards upon the floor or bottom of the furrow.

There is a plough belonging to M. Van Macle, which is capable of being used either as a ridge or moulding plough, or as a turn-wrest plough. It has two mould-boards, of slight curvature, which are respectively hinged to the sides of the throat; they are connected together at the hind end by a curved bar, which passes horizontally through a clamp, attached to the foot or hind bar of the plough-body; and the bar is fixed in the clamp by a set-screw, when the mould-boards have been adjusted. When the mould-boards are caused to stand with their hind ends equidistant from the central line of the body, the plough may be used for moulding or ridge-work; and by setting them so that one mould-board will serve as a land-side plate, the implement can be employed as a turn-wrest plough.

Dr. Spreagel and Co., of Regenwalde, Pomerania, exhibit a model of a water-furrow plough, which, in addition to a pair of expanding iron mould-boards, is furnished with two long flat wooden mould-boards, connected to the inner face of the former, at the hind end, and extending out backward, so as to form a continuation thereof,—being adjusted, like the iron mould-boards, by means of two small bars, jointed to them, and connected at the centre by inserting a pin into one of a series of holes in each bar.

There are likewise three double mould-board ploughs (one British, and two French), with apparatus attached for drilling or depositing seed; and they will, therefore, more properly come under notice when treating of drills and such like machines.

SKIM OR PARING PLOUGHS.

The next description of plough that we shall notice is the "surface," "skim," or "paring" plough, which is an implement employed for cleaning wheat, bean, and pea stubbles, after harvest, for paring grass land preparatory to burning, &c. In this class of ploughs no mould-boards are used, as the object is, not to turn over the earth in thick slices, but to skim or stir it near the surface: this is effected by broad shares, working at a little distance below the surface of the soil.

Mr. Samuelson, of Banbury, exhibits a skim-plough, consisting of two broad-shares, affixed by means of curved iron stems or bars to a forked iron frame; from the forked ends of the frame the handles of the plough project; and to the other end of it the whippletrees for the horses are attached. The frame runs upon three wheels,—a small one at the fore end, which can turn freely in any direction, and a pair of larger ones at the hind end thereof. The shares are affixed to opposite sides of the frame, one in advance of the other, with the wings or side points of the shares pointing inwards and extending across the central line of the frame, so as not to leave any portion of earth unacted upon between them.

Messrs. Hill and Co., of Brierly Hill Works, Dudley, have an improved skim-plough, which consists, like the above, of of a forked frame, mounted on three wheels; but in this case the two broad-shares, instead of being secured to the forked frame, are fastened to an inner frame, which turns upon an iron rod or pin near the hind wheels, and the side bars thereof are extended to form the plough-handles; so that by pressing upon the handles the shares may be raised. To the transverse bars of the inner frame is fixed a single curved tine, with a chisel-shaped point, which works in advance of the broad-shares, in the centre of the space included between the outer ends or points thereof. Behind the broad-shares are two curved tines, the upright stems of which pass through eyes or guides, carried by the inner frame; and the tines are suspended from two levers, the handles of which project beneath a rod that connects the two plough-handles; so that, when the latter are pressed down, in order to raise the broad-shares, the small handles will be pressed down by the cross-rod, and the tines will consequently be raised; but the tines can also be lifted separately, by means of their lever-handles, without it being requisite, at the same time, to raise the broad-shares.

Messrs. Cottam and Hallen exhibit a skim-plough, constructed like that of Messrs. Hill and Co., but without the three tines and their appendages. For the purpose of readily securing the inner and outer frames immoveably together, and releasing the inner frame when it is desired to raise the broad-shares, the outer frame is furnished with two short upright notched or hooked bars, one at each side, near the fore end of the inner frame; and a flat iron bar, which lies upon this end of the inner frame, fits into the notches of the bars, and so holds down the fore end of the inner frame. When it is required to raise the shares, the bar is drawn back by means of a long rod; and the shares can then be raised by pressing down the handles of the inner frame.

Mr. J. Smith, of the Albert Iron Works, Uxbridge, has a skim-plough with two broad-shares affixed to an inner frame, which is capable of moving on a horizontal rod in the outer forked frame, as above described; and behind the broad-shares are two curved tines, with sharp points, which can be raised by a lever action, termed "Lomax's patent movement."

The above-mentioned skim-ploughs are all made of iron; but a model of one with a wooden frame is exhibited by M. De Porquet, of Tavistock-street, Covent-garden. The frame is rectangular, and is supported by a pair of wheels at the front, and a single small wheel at the back. The broad-shares are fixed to the lower ends of long inclined wooden levers, which terminate, at the upper ends, in the plough-handles, so that, by depressing them, the shares can be raised. The line of draught can be adjusted by shifting the drag-link along a notched iron bar, which extends between the front ends of the side bars of the frame.

There is another skim or surface-plough amongst the implements from Wedlake and Co.'s Works, Hornchurch, Essex. It is very different from the preceding ones, and resembles a double-furrow plough, divested of its mould-boards and land-side plates. There are two wooden beams, secured together at the distance of about a foot apart, and connected at the rear to a single pair of plough-handles. To each beam is attached a flat plate or plough-body, which carries a broad flat share with two small projections or soil-breakers thereon; one share works in advance of the other; and before each share an ordinary coulter is fixed.

BROAD-SHARE, SCARIFIER, AND SUBSOIL PLOUGHS.

The notice of the skim or paring plough naturally leads to the consideration of the class of implement known by the name of the "broad-share, scarifier, and subsoil plough;" as the latter performs the work of a skim or paring plough, and is also used as a scarifier, and as a subsoil plough.

The most efficient implement of this class appears to be that invented and manufactured by Mr. Bentall, to which, in addition to prizes obtained from the North Lincolnshire Agricultural Society, in 1848, and the Royal Agricultural Society, in 1850, a Great Exhibition Medal has been awarded. It consists of an iron frame or plough-body, fixed to the hind end of the beam, and carrying, at the back, a broad-share, from which a long point projects in advance of the body, for the purpose of directing the implement onwards in a straightforward course, and causing it to keep to its work. Two slots or openings are formed in the frame or body, to receive two short horizontal blades or knives, which are fixed therein by wedges when the plough is to be used as a subsoil plough. The beam is provided, at its fore end, with a guide-wheel; and to either side of the beam, near its hind end, a square-sided iron arm is bolted, at right angles thereto. To the back of each arm is affixed a slotted bracket, receiving an upright bar that carries the axis of one of the two hind running wheels of the plough; and to the front side of each arm is fastened a stalk or bar that carries a broad-share, somewhat smaller in dimensions than the central broad-share. When the implement is to be used as a surface or skim plough, it is worked with the three shares, but without the two horizontal knives before mentioned; and for fallowing, the broad-share is formed with two prongs at the back, which will bring all kinds of grass and rubbish to the surface. It may be employed as a scarifier, by substituting chisel-pointed tines for the broad-shares; and it is convertible into a subsoil plough, by removing the arms with the small broad-shares and wheels, substituting for the large broad-share one of smaller dimensions, and affixing the two horizontal blades or knives to the frame or body that carries the central broad-share.

Mr. Bentall also exhibits a "ridge plough," constructed upon the same plan as the above,—two bent blades or sharp-edged tines (curving inwards toward each other) being substituted for the two side shares; and each arm having a slot formed along it to receive the stem of the blade or tine, so as to admit of the blades being set at a suitable distance, to cut away the weeds at the sides of the ridges. By the addition of a pair of mould-boards or breasts and a ground or sole-plate, this is rendered a useful implement for moulding-up root-crops, &c.

Messrs. Ransomes and May exhibit a broad-share, scarifier, and subsoil plough, which, like Mr. Bentall's, is furnished with three broad-shares and three wheels,—two near the hind part and one near the fore part of the beam, but differs from his plough in its details. The body of the plough carries a broad-share in front, instead of its being fixed at the back and preceded by a long point, as in Bentall's. The plough-beam is constructed upon the truss principle, before described; and upon it, at the rear end, is fixed a hollow iron cross-beam, which is rounded upon the upper and under surfaces along its central line, but flattened out at the edges. This cross-beam carries, near each of its ends, two narrow iron bars,—one passing above and the other below, and united together, so as to form a compound bar. To one end of each of these compound bars, an upright rod, carrying the axle of one of the hind running wheels, is secured; while, at their other ends, the stem of the smaller broad-shares are respectively attached. These shares follow the wheels, which run upon the undisturbed ground, and, consequently, leave no track upon the finished work. When fitted with chisel-pointed tines instead of broad-shares, the implement forms a scarifier; or, by removing the cross-beam and its appendages, it may be converted into a subsoil plough.

Mr. J. Warren exhibits an implement very similar in its general character to Mr. Bentall's broad-share, scarifier, and subsoil plough, except that, in this instance, the central broad-share is fixed at the front of the plough-body, and has a long bar or sole extending behind it.

SUBSOIL PLOUGHS.

In the construction of "subsoil ploughs," "subsoil pulverizers," and "sub-pulverizers," which work in the furrows made by the ordinary plough, but penetrate to a greater depth, simplicity and strength are alike essential. Their use is to break up the floor of the furrow, and thoroughly stir and pulverize the subsoil or earth: whereby the escape or drainage of surface water is facilitated, and the fertility of the land, by admitting air and moisture to the subsoil, and mixing the latter with the upper soil, is increased. A very efficient implement of this kind is that invented by Mr. Read, of Regent-circus, which has gained several prizes at the meetings of the Royal Agricultural Society. Two specimens of it are exhibited by Messrs. Barrett, Exall, and Andrews. The implement consists of a straight beam, having a pair of handles at the hind end, and a bridle or hake at the fore end. At the heel of the beam a mortise is made, to receive a strong iron stem, which carries at its lower end the share or stirrer, and is fixed at the desired height by driving wedges into the mortise. The beam is carried by two pairs of wheels, one pair near the bridle and the other pair a short distance before the share; the wheels of each pair are set close together, to admit of the same travelling in the furrow; and the axles of each pair of wheels are carried by an upright stem, which projects upwards through a mortise in the beam, and is adjusted by wedges like the stem of the share: the wheels not only support the entire weight of the plough, but they likewise cause the share to work parallel with the bottom of the furrow in which they are travelling. The share corresponds in size with the ordinary mole-share, but its shape is different: the hind part is horizontal, but the fore part is slightly inclined downwards, and presents a broad or chisel end to the soil; and the front edge of the stem, at the lower part, gradually projects forward, terminating on the inclined part, near the front edge thereof, and forming a coulter or cutting edge.

A two-share subsoil plough is also exhibited by the same firm. It is made with a common beam and handles, and a single pair of wheels at the fore end of the beam. To the hind end of the beam is affixed a strong iron plate or body; from the front of which project two spiked shares, one above and in advance of the other, in the same vertical plane; so that the first share will break the upper crust of the subsoil, and thus lessen the work of the second share, which (being of a ⌓ or O-shape in the transverse section) leaves an arched drain to carry away the top water to the main drains.

Messrs. Wilkie and Co. exhibit an iron subsoil plough, constructed on the plan of the late Mr. Smith, of Deanston. The beam is arched or curved considerably, just above the throat, and is strengthened by framework or bracing; it is provided with a pair of handles, of the usual form; and at the fore end there is a single wheel, to travel on the bottom of the furrow and regulate the depth at which the share shall work. The plough has a large single share, and two prongs or land-breakers, for pulverizing the soil,—one being affixed to the back of the share and the other to the plough-body.

A plough of similar construction is contributed by Messrs. W. and J. Ritchie; but in this instance there is a narrow plate or mould-board, about six inches long, behind the share, and forming a continuation thereof; and the prongs or land-breakers are both affixed to the body of the plough.

Messrs. Cottam and Hallen also exhibit a plough of this kind, having a large single share with a projecting prong behind.

A model of a grubber or sub-pulverizer, exhibited by the Rev. T. Digges La Touche, of Killenaule, Ireland, has a single share, from the side of which a flat share or sole-plate projects backwards, horizontally, at a considerable angle with the central line of the plough-body, and carries three prongs or land-breakers.

In a subsoil plough, exhibited by Messrs. Wedlake and Co., the beam is inclined, and supported, at the fore end, by a narrow gallows or upright frame, fitted with a small wheel, to run upon the floor of the furrow. The plough has a flat iron body, with narrow sole-plate and narrow chisel-pointed share. The hake or bridle is supported by the gallows, and connected by two draught-chains with the back part of the body, just beneath the heel of the beam.

Mr. R. Coleman, of Chelmsford, contributes a sub-pulverizer, the beam of which consists of two parallel iron bars, fixed at a small distance apart, and carrying the axes of two bent bars, which work between them, and form the frame or body of the plough. These bars carry, at their lower ends, a narrow sole and share; and their upper ends are connected together by a rod. One of these ends extends upwards, to serve as a lever, by depressing which, the bars are caused to turn upon their axes and raise the sole and share. The lever is retained in any desired position by passing a pin through it and through two arched plates or bars, between which the lever is situated. The lower parts of the bent bars stand in inclined positions when the implement is at work; and the edge of the front bar is bevilled or sharpened, to cut through the soil. At its heel, the beam is supported by a pair of wheels, set close together; and, at its fore end, by a single swivel-wheel.

Messrs. J. & F. Howard exhibit an iron subsoil pulverizer having two beams, united together at the fore end, and each terminating at the other end in a handle. To these beams three curved pointed tines are fixed, one before the other, in a diagonal line. The beams are supported by two wheels at the fore end and a single wheel at the back; the stems that carry the axles of the wheels are all capable of being adjusted to the required height; one of the fore wheels is connected to the off-side or right-hand beam, so as to run in the furrow; and the other two wheels are connected to the near-side beam, and therefore travel on the land.

Messrs. R. Gray and Sons, of Uddingston, exhibit a subsoil pulverizer with three curved tines, arranged in a diagonal line, and so connected to the beam as to admit of the first and last tines being shifted laterally, to suit the breadth of the furrow. The middle tine is firmly fixed to the beam; but the first and last tines are each connected to the beam by a horizontal arm, projecting from the upper part of the tine, and passing through a mortise in the beam. There is a pair of wheels at the fore end of the beam, connected by a rod (which passes up through a mortise in the beam) with a lever that extends backwards nearly to the handles of the implement, and is capable of turning upon a fulcrum or axis carried by the beam just before the first tine. By depressing the hind end of the lever, the wheels are raised; and the lever is retained in the desired position by causing a pin, upon the end of a long trigger or catch-bar (carried by the lever), to enter one of a series of holes in a bar that stands up from the beam.

Mr. J. Comins has contributed a subsoil pulverizer which gained a prize from the Royal Agricultural Society in 1849. The beam is of iron, with ordinary handles, and has a single wheel at the fore end. To the heel of the beam a common mole-share is connected; and, in advance of the beam, there are two tines or coulters with broad pointed feet, which work at a higher level than the share.

A "subsoiler" of peculiar construction is exhibited by Mr. Laycock. It consists of an iron cylinder, with two rows of curved spikes or tines projecting from its outer surface; the cylinder is fixed upon a horizontal axle, carried by a frame like a common cart frame, which travels upon two small running wheels; and the frame is furnished at the front with a pair of shafts for a horse, and at the back with a pair of handles for guiding it. As the implement is drawn onward, the tines penetrate and break up the soil.

In the French department, M. Bazin, of Mesnil St. Fermin, Oise, exhibits a subsoil pulverizer with three tines, having broad pointed ends.

In the American department, Messrs. Allen and Co., Starbuck and Son, and Prouty and Mears, exhibit subsoil ploughs of like construction. The beam and handles are of wood; the body is a flat iron plate, to which a single wing share is is affixed; and at the back of the share there is a narrow plate or mould-board, attached to the body about two inches above the sole, and inclining in two directions: viz., it rises slightly as it extends backwards from the share, and it inclines laterally downwards from the body.

Mr. W. Bryant, of Nashville, Tennessee, exhibits a model of a subsoil plough, similar in construction to a common furrow plough, and having a mould-board of the ordinary shape; but the heel of the beam extends beyond the point where the handles are connected thereto, and receives a curved tine or coulter (made of wrought iron, with a steel edge), which works in the furrow produced by the plough-share, and loosens the subsoil to the depth of two or three inches. The share is formed with a gouge-shaped point. The handles embrace the beam (to which they are secured by a bolt), and, passing downwards, are bolted to the land-side plate.

In the Belgian department, M. D'Omalius has a subsoil plough with a single wing share, fixed to a strong high iron body. There is also a subsoil plough from M. Dufour, of Neufville, Hainault, with an inclined wooden beam, supported at the fore end by a high gallows or frame of thin iron rods, mounted upon two wheels. It has a share, a coulter, and a mould-board,—which latter consists of a long straight iron plate, slightly curved or bent back on the upper and under edges, and standing out from the body at an angle of about 40° in a horizontal plane; and there is a small flat share, of a triangular shape, which is affixed to the back part of the body, and follows the same in the central line thereof.

The Prussian department contains a model of a subsoil plough with three curved tines, two of which are fixed, side by side, to a cross-bar at the heel of the beam, and the third is attached to the beam some distance in advance. The plough is followed by a wooden roller, which is connected by a bar or rod with a cross-bar that connects the handles.

In the Austrian department, Prince Von Lobkowitz exhibits a subsoil plough, of a form almost as primitive as one of the Indian ploughs described at p. 223. It has a long straight wooden beam, with a pair of straight handles affixed to the sides thereof; and the heel of the beam is mortised to a curved wooden bar, which is also attached to the beam by an iron bolt. The curved bar stands in an inclined position, and carries at its lower end a plate-iron central-pointed share, with the edges curved downwards at each side.

TRENCHING AND DRAIN PLOUGHS.

The last class of ploughs which we have to notice comprises those constructed for the purpose of forming channels to carry off the water, and thereby effect the drainage of the land. This section properly embraces merely "trenching ploughs" and "drain ploughs;" but we purpose to include in it the "deep soil ploughs;" because these implements are alike suitable for deep ploughing, and for the formation of trenches or drains.

Messrs. J. and F. Howard exhibit a plough, constructed on the same plan as those described at p. 215, but of larger size, to render it suitable for extra deep ploughing.

Messrs. Ransomes and May have a plough, of large dimensions, designed to be used in the West Indies for deep ploughing and for forming trenches: like all the others exhibited by that firm, it has a trussed beam; the coulter is adjusted in the manner explained at p. 217; and the mould-board is capable of being expanded from thirteen to twenty-one inches.

Messrs. Gray and Sons contribute a large "deep soil or trenching plough," of the ordinary form, having the hind part of the mould-board hinged to the fore part, and capable of being expanded to the desired extent by means of a rod, attached to the inner side of the mould-board, and passing through an eye on one of the handles, where it is fixed by a screw.

Mr. Slight, of Leith Walk, Edinburgh, exhibits a "Tweeddale trench plough" and a "Tweeddale subsoil trench plough." The first is a large strong plough, resembling the ordinary furrow plough, except that the mould-board curves in at the top instead of outwards. It is designed to take a furrow-slice fourteen inches deep, and to precede the second plough, which is constructed on the plan of Read's subsoil plough (described at p. 288), but has a broad inclined share, with a pointed fore end, to cut a slice from the bottom of the furrow, and thereby facilitate the removal of such portion of the soil by means of spades or scoops.

Mr. E. Alexander, of Taylorton, Stirling, exhibits models of two iron "draining ploughs," for which he obtained prizes from the Highland and Agricultural Society of Scotland, and from the Stirling Agricultural Association. The first plough is drawn by from ten to twelve horses, and removes a wedge-shaped slice of the soil, from fifteen to eighteen inches deep, sixteen inches wide at top, and seven inches wide at the bottom. The bottom cut is made by a single wing share, and the two side cuts by two straight coulters. One of these coulters is fixed in front of the land-side plate of the plough, and inclines backwards in a vertical plane. The other coulter inclines laterally as well as backwards; and is fixed at the lower end to the wing or side point of the share, and at the top to an iron frame, projecting from the side of the beam. The sole-plate rises gradually from the back of the share, and terminates nearly upon a level with the beam. The mould-board commences just behind the first-named coulter, and, when it reaches about the middle of the length of the sole-plate, it curves outwards to the edge of the same: therefore, when the slice of soil is cut by the share and coulters, it ascends the sole-plate, and is deposited by the mould-board at the side of the drain. The second plough cuts a further slice from the bottom of the drain, from ten to twelve inches deep, and finishes the drain to the exact breadth of the tiles that are to be laid therein. This plough is constructed like the other, with the exception of some necessary alterations in the depth of the coulters, land-side plate, &c., to suit the increased depth of cut. At the fore end of the beam of this second plough a metal cone is mounted upon an upright rod, fixed to the side of the beam, so as to run like a wheel against the side of the trench or drain, and serve to guide the plough.

Mr. J. Ferguson, of Stirling, also shews a model of an iron "draining plough." It is provided with a single wing share, to give the horizontal cut; the near-side cut is made by a curved coulter, affixed at the bottom to the share, and at the top to a long rectangular iron frame, which serves as a substitute for the ordinary beam; and the cut on the right hand or off-side, is produced by a straight coulter, which inclines forwards as well as laterally, and is attached to the wing of the share at the bottom, and to the "plough-frame" at the top. The sole-plate rises above the level of the surface of the soil, and is there united to the mould-board; and by their conjoint action the soil is lifted from the bottom of the trench or drain and deposited at the side thereof. The plough-frame is placed within another frame, which may be termed the "plough-carriage"; it is supported at the fore end by a pair of wheels, connected to it by a swivel frame, so as to enable the ploughman to guide the wheels by means of a long rod attached to the swivel frame; and the hind end of the carriage is supported by a single wheel, which travels on the floor of the drain. At the back of the plough-frame there is a handle for the ploughman to hold when the implement is at work; and the fore end of such frame can be raised, when required, by means of a long lever, the pivot or fulcrum of which is carried by an arched piece that rises from the plough-carriage.

We may here likewise notice the model of a "draining-machine," contributed by Mr. Gregory, of Beverley. The frame of the machine travels upon four small wheels, and carries beneath it a horizontal share of peculiar construction. Its cutting-edge is straight, and its sides are turned up at right angles, so as to form a kind of trough, which extends to the back of the machine. In this trough is an endless band, which moves upon small rollers, and carries the excavated earth to the back of the apparatus. The soil is loosened and broken at the top, just in advance of the share, by an Archimedean screw, on the lower end of an inclined revolving shaft. By means of suitable gearing, motion is communicated from a winch-handle to the endless band and to the inclined shaft, and, at the same time, to the axle of the pair of fore wheels, whereby the propulsion of the machine is effected.

Mr. J. Fowler, jun., of Bristol, exhibits a very efficient "draining plough," capable of forming drains at any depth not exceeding four feet, and at the same time depositing pipes therein, without disturbing the surface soil; and this, as it is stated, at less than half the usual cost. The drain is formed by a plug or share, of similar shape to the common mole-share: that is to say, it consists of a small iron cylinder, which terminates in a point at the fore end. To the back of the plug is attached a rope, on which the drain-pipes are threaded; so that as the plug moves onward, and forms the drain, it draws the pipes after it. The plug is affixed to an upright blade or coulter, which cuts through the soil without much disturbing the surface; and it is preceded by a small coulter that curves backwards towards it. The two coulters are connected to and supported by the fore end of a rectangular iron frame, which is bolted at its ends to the centre and hind end of a long outer frame, of nearly twice its length; so that the two coulters will be situated near the middle of the outer frame. The outer frame is supported by a pair of rollers at its fore end, and, near the hinder part thereof, by three parallel rollers, connected to the inner frame; and it is caused to advance along the field by being connected by a wire rope with the barrel of a capstan, which is made to revolve by the power of two or more horses. As the plough advances, the coulter and plug can be raised or lowered, according to the nature of the surface, in order to ensure the desired level or fall of the drain. This is effected by the ploughman turning a hand-wheel, which communicates motion through a worm and worm-wheel to a small wheel or pinion in gear with a rack on the back edge of the coulter,—the ploughman's eye being guided by observing a "try-sight," balanced upon the plough, and a cross-staff erected at the end of the field. In commencing to operate, a hole is dug, into which the coulter and plug are lowered to the required depth; and to the back of the plug is secured a rope, with the drain-pipes threaded thereon. When a length of drain is completed, not exceeding 225 yards, the plough is run into another hole, and the rope is unhooked and pulled out backwards, leaving the drain-pipes in their proper positions in the drain.

In the American department, Messrs. Allen and Co. exhibit a strong trenching plough, apparently well adapted for trenching fields for rice. It is made upon the plan of the common plough; but the mould-board is of a peculiar shape,—the upper part curving over to a considerable extent and then rising up vertically. Messrs. Starbuck and Son have a deep soil or trenching plough of the ordinary make, with a "lock coulter," which rises from the land-side of the share, passes through the beam, and is secured by a nut.

In the French department, M. Pardoux has an iron trenching plough, the beam of which is bent downwards at the fore end, and connected by a rod with the drag-chain; at the bend in the beam two horizontal arms project to receive the bars that carry the axles of a pair of wheels, which are about three feet in diameter; and thin iron rods extend from the heel of the beam to the ends of the arms, and from the ends of the arms to the rod connected with the drag-chain. M. Bonnet exhibits a trenching plough, with wooden beam and handles. The mould-board rises above the beam, and stands in such a position as to form a kind of inclined plane, up which the soil ascends, and is deposited at the side of the trench. The share is a nearly rectangular plate of metal, and presents one of its side edges to the soil in place of a point. This completes our notice of by far the most perfect and satisfactory collection of ploughs that has hitherto been exhibited.

RAW MATERIALS.

GLASS AND ITS MANUFACTURE.

Amongst the mining and mineral products of the Exhibition, there is an unaccountable deficiency of specimens of fine sand, which, considering the vast importance of our glass manufactures, is much to be censured. From Lynn, in Norfolk, not a single specimen is contributed; and from the Isle of Wight but two exhibitors present themselves; although these are the chief localities whence the sand, so largely consumed in the manufacture of our various kinds of glass, is derived. The best-looking sample of sand shewn in this department of the Crystal Palace is from S. Relf, Reigate, Surrey, and stands described in the Official Catalogue as "white sand from the Tunnel Caves at Reigate, usually called silver sand." Near it is another specimen, of almost equal apparent purity, from Reigate Heath, and exhibited by G. Morrison, agent to Earl Somers at Reigate. J. & W. Squire, of Yarmouth, Isle of Wight, next deserve notice; after whom, J. Claxton, from Alum Bay, Isle of Wight,—J. Lee, of Hartwell, near Aylesbury,—T. Smedley, from Landidno, and a few others, display samples of an ordinary commercial character. Those, however, who are interested in this subject, will do well to pass at once to the Eastern end of the Building, and there examine a quantity of fine sand contained in the American department. This sand is from T. Gray and Co., Boston, Massachusetts, and is, beyond all question, the purest article of the kind ever seen in this country. Having been favored with a small portion of it, we have had an opportunity of testing the amount of its metallic contamination, and find this so trivial as to be inappreciable; for, 2,500 grains of this sand yielded but ·08 of peroxide of iron; whereas, the same amount of British sand, of good quality, would have given at least one hundred times this quantity.

Before entering upon the manufacture of glass, it is, perhaps, advisable to explain the mode by which the analysis of sand may be effected without much loss of time or labor. In chemical works on this subject the means prescribed are extremely complex, and require no ordinary share of manipulative power; but, as the true object of the glass-maker is merely to ascertain the amount of metallic impurity, a complete analytical investigation is not only a great loss of time and trouble, but, to a large extent, superfluous and worthless. Hence the following simple mode of assaying sand may be practised by many who could never be prevailed on to attempt a regular analysis:—Having weighed out a portion of the sand to be examined, mix with it, carefully, one-tenth of its weight of pure and recently-heated lamp-black; and then place the mixture in a green glass tube, so arranged in a small furnace, that the portion containing the sand can be made red hot. As soon as this is the case, let a current of pure chlorine traverse the tube,—taking care to condense the resulting products in water, contained in a receiver attached to the other end of the tube, as is usual in such operations. By this means, the oxides of iron, manganese, &c., are reduced to the state of volatile chlorides, and pass, with the excess of chlorine, into the receiver, where they are dissolved in the water,—forming solutions, from whence the oxide of iron may be precipitated by ammonia, and the oxide of manganese by chloride of soda, or chloride of lime. The sand, under this treatment, becomes absolutely pure silicic acid, and is perfectly white when the excess of lamp-black has been burnt off in a muffle. It is not improbable that the muriatic acid so incessantly wasted in our soda works may one day be found applicable to the purification of glass-makers' sand; and thus the disagreeable tint of common glass will no longer interfere with its employment where color is an object.

The position which Great Britain occupies, as regards glass, in the Exhibition, is by no means satisfactory; for, in the highest branch of the art, we are immeasurably distanced by France. Due allowance must, of course, be made for the discouragement and hindrance caused by our late impolitic fiscal regulations, which have retarded, very seriously, the development of this manufacture, and have only recently enabled England to avail herself of the enormous advantages which she naturally possesses for glass-making. Prior to the abolition of the Excise duty on this article, improvement was scarcely desirable; for any alteration in the process, however small, was certain to bring down an increased amount of official insolence and intermeddling on the part of the great fiscal harpy. Thanks, however, to the advancing knowledge of the day, the glass-maker is now unfettered, and a palace, rivalling the most romantic flights of Eastern fancy, proclaims the fact to an admiring world. But we are not quite eertain that the British manufacturer has made, or is making, the most of his opportunity. On the contrary, it strikes us that he is placidly enjoying a self-sufficient mediocrity, and reposes too confidently upon that fluctuating foundation—the amount of his capital. He makes to sell, and abhors improvement until the article he makes becomes unsaleable. His ideas of competition turn always in the direction of price, and seldom or never voluntarily take the higher ground of quality. Hence it will be found, on examining the compartments of the Crystal Palace, that, if we excel at all, it is in the inferior or common kinds of glass; whilst, in the better descriptions, we are left lamentably behind. As in earthenware so in glass, and so in several other things, Great Britain manufactures for the million, but ignores the existence of a higher grade of consumers, and is dependent upon other nations for the development of real excellence. In window-glass, as might be anticipated, the English makers well sustain the character due to their country; and the great improvement which has taken place, in this particular branch, since the repeal of the duty, reflects the highest credit upon such names as those of Chance and Hartley. With the repeal of the duty the old mode of making window-glass by the process called "flashing" virtually perished; and this of course necessitated the employment of workmen accustomed to the new method. Belgium and France were appealed to in this difficulty; and a very few years ago no English workmen could be found to compete with these foreigners. Now, however, matters are much altered for the better; as may be seen on inspecting the enormous cylindrical glass shades displayed in Class XXIV. by Messrs. Chance, of Birmingham. These shades have been made by Englishmen; and, in respect to size and form, leave nothing to be desired. The glass itself is also of a good average quality in color, and very free from air-bubbles, specks, and other imperfections; indeed, if successful competition with foreign producers be the only object of ambition amongst our window-glass manufacturers, that end has been unquestionably attained, both by Messrs. Chance & Co., and J. Hartley and Co. We hope, however, that something more is sought for amongst us; and hence, part of the remarks which we shall offer, in regard to plate and flint-glass, must be understood as having, though in a less degree, an allusion to window-glass.

So far as may be inferred, from the analysis of ordinary commercial samples of window-glass, this substance has not only a very variable composition, but, worse than this, it is out of all keeping with anything like definite proportion. That it should be full of striæ, and therefore refract the rays of light unequally, as it does, so as to produce the most hideous appearances of distortion, is a mere natural consequence of its mechanical composition, which might, and must one day be corrected; but that whole nations should have come to view this defect as an unavoidable peculiarity, is precisely one of those surprising facts which demonstrate the influence of habit over the powers of the mind, and shew how easily human reason can reconcile itself to the most gross inconsistencies. If window-glass had one uniform atomic composition, the tendency to form these striæ would nowhere exist in excess; and therefore their production would diminish as the skill of the workmen increased; but, with the present variable compound, the glass stretches unequally in different parts by an equal application of force, and, in spite of human skill, presents a result alternately thick or thin, as accident determines. That these striæ have not the same composition as the parts surrounding them is very obvious, from the circumstance that, if striated glass be cut to an uniform thickness, and polished on both sides, the optical defects remain but little changed, and occasionally they are found to be increased. Again it is known, that the more complex the composition of any glass may be, the greater the liability to this striated structure,—of which flint-glass offers an apposite illustration; for here, in addition to the ordinary components of glass, the silicate of lead is superadded. Now, the specific gravity of silicate of lead is very high compared with that of silicate of soda, potash, or lime; hence, unless employed in the exact quantity to form a chemical combination with the other silicates, a mere mechanical mixture is produced, of very different densities throughout; and the product, under the action of light, displays, permanently, that peculiar, though fugitive, appearance seen when syrup and water, or alcohol and water, are mixed together: that is to say, a series of curved lines are formed by the unequal refraction of the two fluids, which entirely disappear so soon as perfect admixture has taken place, but which remain in the case of flint-glass, from the utter impossibility of effecting the necessary union between its various parts. Although, however, this cannot be done mechanically, yet, in a chemical way, Nature performs such operations with ease and unerring fidelity. The French chemist, Berthier, long ago proved that many neutral salts combine together by fusion in atomic proportions, and form new and definite compounds. Thus, carbonate of potash and carbonate of soda, when mixed, atom for atom, unite, and produce a compound more easy of fusion than the most fusible of the two;—similarly, either of these carbonates will act with carbonate of baryta or strontia; and again, fluor-spar and sulphate of lime, two remarkably infusible substances, when mixed, melt readily, at a low red heat, into a fluid as mobile and transparent as water. It is useless to multiply examples of this kind, for thousands exist; and the alkaline and earthy silicates form no exception to this almost universal rule. A mixture of silicate of potash and silicate of soda will, if in atomic ratios, fuse much more readily than either of them alone. But now let us imagine an attempt to fuse these two bodies together, in any other proportion than that in which they are naturally disposed to combine;—say that the silicate of soda is in excess; then the silicate of potash would unite with exactly sufficient of the silicate of soda to produce the extremely fusible compound above spoken of; whilst the less easily fusible silicate of soda, added in excess, would form a kind of network throughout the mass. It may be said, that a higher heat would overcome this difficulty, by thoroughly liquifying the silicate of soda; and this is really the plan now used with that view; but, independent of the fact, that the mixed silicate of potash and soda would also undergo a corresponding liquefaction, and therefore favor the separation of the silicate of soda; yet, as chemical union is impossible, from the very conditions of the experiment, even the most perfect mechanical mixture, under the greatest advantages of fluidity, would never generate a homogeneous body. The striæ might indeed be diminished in size; but this would imply a corresponding increase in their number; and if carried very far, complete opacity would result from such an endeavour to subvert the laws of nature. The power of the workman to remedy this defect is therefore limited to the capability of modifying its more salient features: he can neither remove nor destroy it. What we have here illustrated by the simplest of all assumptions, gathers and accumulates into a formidable evil when several silicates are fused together, having considerable differences of specific weight. Thus, in the case of flint-glass before alluded to, there are generally three and sometimes five of these silicates fused together, into, probably, one of the most antagonistic compounds that could be conceived, refracting and dispersing the rays of light in fifty different directions, and demonstrating the unfriendly nature of its coerced union by flying in pieces from the most trivial applications of heat or violence. Yet in flint-glass we are not surpassed, nor indeed equalled, by any other nation; and so thoroughly has this beautiful substance become associated with our industrial reputation, that the name, flint-glass, has been adopted into several continental languages. Nevertheless, it cannot be doubted that a wide field of improvement is open in this quarter, and that some more solid foundation is needed by our manufacturers in this line than the prestige of a name, or the force of capital.

In our concluding remarks we shall point out the direction in which improvement is practicable; and at present it may not be uninteresting to examine the contents of the Exhibition in respect of this kind of glass. The display of goods by Messrs. Apsley Pellatt and Co., is alone sufficient to exhaust the entire subject of flint glass; and the mere inquirer into this branch of manufacture need go no farther to get a perfect conception of the wonders that can be achieved by the manipulation of this material. The *coup d'œil* is certainly most beautiful; but, supported as it is and multiplied by the rival exhibitions of Messrs. Osler, Harris, Bacchus, Powell, Lloyd and Summerfield, and a host of others, the effect is positively dazzling and gorgeous. At a distance, sufficient to cover the faults of refraction, not even the diamond itself has a more pleasing appearance; and, indeed, the glass Koh-i-noor of Mr. Pellatt, displayed in the gallery, might be substituted for the real gem, shewn in the main avenue, without the least risk of detection on the part of the million, or any great loss of brilliancy to the most practised eye, so perfect is the imitation. Is it not then to be deplored, that science has had no hand in mingling its constituents together? But we must turn from this glittering assortment and descend to a lower level, where we shall find Great Britain in disgrace, and suffering severely from comparison with a rival, inferior in capital and natural resources, but conscious of power through the aid of real knowledge, and triumphantly asserting a claim to supremacy in the very perfection of the glass-maker's art. The plate-glass of France casts that of England far into the shade. The productions of St. Gobain stand alone in the Exhibition; they have no competitors; and we are in a condition to prove that chemistry has done this. The plate-glass of Montluçon too adds to the defeat. In examining the refractive aberrations of a mirror, the spectator will find his task facilitated by standing so that the rays of light from any geometrically-shaped body fall upon the glass, at an angle of 25°; when, of course, they will be reflected towards his eye at the same angle. Now gazing intently on the figure in question—and which, in the Exhibition, may be one of the parallelograms formed by the rafters of the roof—let him gently move his head from one side to the other. If the glass be of English manufacture, he will immediately perceive a tumultuous movement in the lines of the figure, as if this were subjected to an undulatory action,—the lines, before straight and parallel, become crooked and convergent in places, and minute objects lose entirely their outline and definition. In the case of the St. Gobain glass, shewn in the French department, nothing of this takes place. As it can serve no good purpose to dwell upon each individual example of imperfection, we refrain from entering further into the comparative merits of the British exhibitors. They are all surpassed by the French makers, both in respect to uniformity of composition and fineness of polish. The St. Gobain Company having had the good sense to place a number of small samples of their glass for the acceptance of those visitors who may feel an interest in the manufacture, we have selected and analyzed one of these little squares, and shall presently detail the result; but our object in alluding to them here is, that glass-makers themselves may procure one of these specimens, and contrast it with a like morsel of English plate-glass. If the two be laid side by side upon any moderately light-colored ground, and a distant object, as a chimney for example, be subjected to reflection, it will be found, that whilst the French glass gives a clear sharp outline, the English reflects either two or more images, in a hazy and imperfect manner. There is no getting over this fact; and therefore improvement is imperative. The mode of making plate-glass being, so to say, identical in the two countries, the difference here remarked can arise from nothing else than a difference in composition.

In France, as in England, the ingredients are mixed with some care, and introduced into a crucible, heated by a powerful furnace. These ingredients are sand or silica, carbonate of soda, and carbonate of lime, with perhaps a little ground felspar in some cases. The carbonate of soda is first attacked by the silica, and its carbonic acid driven off, whilst the remaining silica and carbonate of lime become imbedded in the vitrifying mass. As the heat increases, a more perfect fusion takes place; and then the carbonic acid of the carbonate of lime makes its way through the fused materials; by which they are mechanically mingled together during the effervescence, which is technically termed the "boil;" and, provided no after separation ensues from the process of "settling," the whole crucible or "pot" of glass will have a uniform composition. But, as we have seen, this depends altogether upon the relative proportion of the materials towards each other; for an excess of either one or other of the bases will destroy the homogeneous character of the whole, and introduce a plexus of striæ. Now the plate-glass of St. Gobain is almost exactly an atomic compound, and consists of one atom of the trisilicate of soda and one atom of the trisilicate of lime, with a small per-centage of alumina. The union is therefore complete; and when it is remembered, that the celebrated French chemist, Gay Lussac, was regularly employed as an adviser to this company, and that his son, M. Jules Lussac, retains that appointment to this day, it is not very surprising that our manufacturers are defeated in the article of plate-glass. Science must ever take the lead of prejudice and custom.

The examination of English plate-glass fully corroborates the general effect deduced from the action of light. There is no approach to an atomic arrangement: the principal constituent is trisilicate of soda, but variable quantities of lime, alumina, and even magnesia, exist in it. Potash is sometimes present, and oxide of iron is invariably so; but in not one single instance, out of 17 samples examined with great care, could so much as a suspicion of the doctrine of combining proportions be gathered from the result of the analysis. Similarly fruitless was a research instituted upon flint-glass, both British and Foreign. Of 35 samples analyzed, no satisfactory evidence was adduced to favor the opinion that science had been a helpmate to industry, or was at all concerned in this branch of manufacture. There are, however, some points of vast interest associated with the practical working out of this matter. Potash is known to give a more brilliant and harder glass than soda, and alumina seems to tend in the same direction. The Bohemian glass, so celebrated throughout Europe, is a glass of this description, and contains silicate of alumina, silicate of lime, and silicate of potash, but not in chemical proportions. This glass is therefore striated, as may be seen by examining that in the Austrian department; but it seems to permit of a more perfect decoration by metallic oxides than can be developed in glass of lime and soda. This very probably depends upon the alumina contained in it. From some singular oversight, the use of carbonate of baryta has not yet found its way into the composition of glass, though we can scarcely conceive a more hopeful material. This substance may be had in large quantity in the North of England, of great purity, and at a merely nominal cost as compared with its value for such a purpose as glass-making. That it would fuse readily with a due amount of soda, and give "a boil" as well as chalk, there can be no doubt; whilst its great density will certainly improve the refractive power of the resulting product, and thus rival the brilliancy of lead or flint-glass, without imparting that softness and liability to receive scratches which are so objectionable in the latter variety. One difficulty may perhaps reside in the want of information concerning the quantity to be employed. But this is easily adjusted; for it has been demonstrated that, during vitrification, the silicic acid unites to bases in the proportion of three atoms to one: consequently, three atoms, or 138 parts, will always require one atom of each base. Therefore, this weight of good dry sand may be set against 54 of dry carbonate of soda, 70 of carbonate of potash, 50 of pure marble or chalk, 99 of carbonate of baryta, and 112 of oxide of lead or litharge. Suppose, then, that the object is to employ carbonate of baryta for the first time, here 6 atoms, or 276 parts of sand, 1 atom or 54 parts of dry carbonate of soda, and 1 atom or 99 parts of carbonate of baryta, may be mixed and fused together with every prospect of obtaining a good result; or 9 atoms of silica, 1 of carbonate of potash, 1 of carbonate of soda, and 1 of carbonate of baryta, might be tried without fear of failure. Again, in the case of flint-glass, 112 of litharge, 54 of soda, and 276 of sand, would probably succeed; or an additional atom of trisilicate of potash might be used. For many years past, M. Dumas, now, perhaps, the first chemist in France, has been in the habit of demonstrating to his pupils that glass of all kinds, when properly made, must necessarily be an atomic compound; and yet we scarcely expect to find a single British glass-maker who will admit that his art is susceptible of such decisive and beautiful simplification.

To assist, as far as we can, in the attainment of this end, we shall proceed to describe a simple means for the analysis of glass, which will enable any person, possessed of even very trifling chemical skill, to determine the composition of any given sample of glass in a comparatively short time. From the nature of the material, it becomes necessary to divide the analysis into two distinct portions: one of which has for its object the estimation of its alkaline ingredients; the other, that of the earthy metallic and silicious matters. Having heated a sufficient quantity of the sample in question to dull redness, it must be suddenly thrown, whilst still hot, into a basin containing cold water. In this way it becomes cracked and flawed in all directions, so as to favor its reduction into powder. When dry, it must, therefore, be carefully ground in an agate or steel mortar, until it has the appearance of fine flour. Nor is it a matter of indifference whether this takes place in contact with water or not; for glass, in this extreme state of comminution, readily gives up a part of its alkali to water; and hence, if ground in the presence of that fluid, the resulting analysis would prove incorrect. But we will suppose that a quantity of fine powdered glass has been obtained as above indicated, and the amount of its alkali is desired; then weigh out 100 grains of the glass, and carefully mix with it 200 grains of pure fluor spar in a similarly powdered condition. Place the mixture in a platinum or leaden vessel, and pour over it 500 grains of strong sulphuric acid,—stirring the whole well together with a silver spoon; but taking care not to remove any portion of the materials. Next, apply a heat of about 212° Fahr.; and as the process draws to a conclusion, this may be raised as high as 300°. When all evolution of gaseous fumes has ceased, water may be poured on the residuary mass to the extent of four or five ounces, and the mixture thrown on a filter. After the clear fluid has passed through, a little more water must be added to the filter, so as to wash out the whole of the soluble matter;—these washings being joined to the original clear fluid, which consists of sulphate of soda or potash, or both, with a quantity of sulphate of lime, and perhaps also of magnesia and alumina. To this an excess of carbonate of ammonia must now be added, to admit of the separation of the earthy salts being effected by filtration. The clear solution is next boiled down to dryness; and the residue is heated red hot for a minute or two. The residue is the soda or potash, or both, formerly contained in 100 grains of the glass, but now united to sulphuric acid. Having ascertained its weight, the relative proportions of potash and soda may be found by testing its content of sulphuric acid with a barytic solution, and calculating the result by the well-known Archimedean equation; or by dissolving the mixed salt in a small quantity of water, and, after adding an excess of tartaric acid, leaving the whole for a few hours covered up in a cool place: almost the whole of the potash will separate in this way as bitartrate of potash. The quantity of alkali may be determined from the atomic constitution of the alkaline salts. Thus, supposing the dry residue altogether composed of sulphate of soda, then as 72 grains of it indicate 32 of pure soda, the result may be obtained by the rule of proportion. The amount of alkali being known, another portion of the powdered glass must be employed for ascertaining the remainder of the ingredients. That is to say, 100 grains of the sample must be mixed with 200 grains of pure potash, and the whole fused together in a silver crucible, at a red heat, until perfect liquefaction ensues, when the crucible and its contents may be withdrawn from the fire, and, as soon as cool enough, boiled in half a pint of pure water, so as thoroughly to dissolve the fused mass from the crucible. An excess of nitric acid being poured into the solution, the mixture is then evaporated to dryness,—by which means the silicic acid is rendered insoluble; consequently, on the application of water, this remains, and may be dried and weighed; whilst the lime, alumina, and lead of the glass may be separated from the soluble portion by the addition, first, of sulphuretted hydrogen, which separates the lead—then of ammonia, which throws down the alumina—and next, by pouring in carbonate of ammonia, which precipitates the lime as a carbonate. Thus, therefore, the alkaline matters are found by one process, and the silica, earthy, and metallic constituents by another, both of which may be conducted at the same time. It has been recommended to employ carbonate of baryta in the analysis of glass; but the high temperature required with this substance dissipates a portion of the alkaline components, and thus leads to serious errors. Even mere fusion in a glass furnace expels soda from glass, and renders it more and more infusible; but this expulsion is much favored by the presence of baryta. The above method of analyzing glass is therefore to be preferred to the baryta plan by individuals not habitually engaged in manipulative chemistry. Until manufacturers adopt the custom of examining every specimen of glass they make, the chances of improvement are extremely limited; for success one day is constantly followed by failure in another, without any means of checking or controlling the manufacture. It is generally said that the best glass is made during cold weather, as at this time the furnaces give most heat, from the increased activity of the draught, through the augmented barometrical pressure. The assertion itself is most likely true; but the explanation of its cause leaves much to be elucidated, even if a higher heat prevails at the period in question. Admitting the beneficial agency of a high temperature, or "sharp fire," as it is termed, this perhaps depends upon the sudden fusion of the materials before the carbonic acid of either of the carbonates has had time to escape: consequently, a much more active "boil" and thorough intermixture must occur under such circumstances than where this gas has been suffered to pass off in great part before fusion. This, however, would only diminish the individual size of the striæ by multiplying their number; and such glass must, even under the most favorable circumstances, suffer greatly by comparison with that of St. Gobain. Nor can improvement be hoped for until, as in France, in this particular case, science is linked hand in hand with manufacturing industry. Since the grand discovery made by Dalton, that Nature works in definite proportions, there can be no excuse for continuing to follow the doctrine of chance, with its occasional successes and frequent failures—the alternations of hope and despair. The laws which regulate the entire universe are not more immutable than those which tend to unite silica and soda in certain equivalent quantities; and man might attempt, with the same prospect of success, to arrest the annual revolution of the earth as alter even the very simplest of these atomic arrangements. It is therefore simply futile to battle with such a power; for even when success seems on the point of attainment, we find Nature reasserting her dominion, and stamping those works of man which have been pursued in defiance of her laws, with the indelible impress of imperfection and error.

That glass of all kinds may be made in this country, quite equal to that of St. Gobain, is saying no more than that Nature's laws are universal. But, remembering the great facilities we possess as a glass manufacturing nation, the attainment even of such a result is but a sorry flight of ambition. We are placed in a position which demands from us something more than mediocrity or successful competition; as no nation in the world possesses the same amount of natural advantages. In fuel, in soda, in sand, in chalk, in litharge, we are naturally rich to overflowing; our capital and commerce give us the command of every market; our manufacturers need only ask and have. So long as a miserable fiscal impost sat like an incubus upon the back of the glass-making interest, inferiority was unavoidable; but the humiliating aspect of the British plate-glass throughout the Great Exhibition is scarcely palliated by this excise reminiscence; and we refrain from terming it a national disgrace, only under a belief that already improvement has begun, which will thrust these specimens into the department of the past.

LABOR-SAVING MACHINES.

While pursuing our investigations in this very interesting branch of the Exhibition, we have been struck with the paucity of specimens of labor-saving machines compared with the number which must exist in this and other countries; and, in now bringing our notice of this department to a conclusion, we are the more convinced of the inadequate manner in which this branch of industry is represented. Not to mention the numerous contrivances which have emanated from British ingenuity, France and Belgium have produced many valuable inventions which would come under this class, but are, for the most part, wanting; while the United States, which uses mechanical contrivances in almost every department of domestic economy, even to the nursing of the rising generation, is here scarcely represented at all. It is, doubtless, to the defective state of the patent laws that this is, in great part, owing; for inventions of this class are precisely those which are looked upon as fair game by enterprising manufacturers, since they offer no obstacle to a speedy return of profit when thrown upon the market; whereas, inventions of a more complex nature present some obstacles to their easy and profitable appropriation. In continuing our review of labor-saving machines, with that degree of order of which the varied quality of the materials are susceptible, we notice a machine for forming hemispherical or dome-shaped paper shades for lamps, exhibited by Mr. W. Taylor, of Nottingham. The machine is apparently of French origin. It consists principally of a series of cords, which radiate horizontally from a ring, and pass over separate pulleys, mounted at equal distances apart on the circular framing of the machine; and their lower ends are connected by helical springs to a weighted ring. Above the cords there is a moveable hollow copper dome, placed with the apex downwards; the dome is formed with corrugations on its external surface (extending from the apex to the base) corresponding in number with the cords above-named; and it is heated by steam [in ordinary use it is found more convenient to heat it by the combustion of gas within it]. A circular piece or disc of moistened paper, having a hole cut in the centre thereof, is laid on the cords, with its centre over the centre-piece or ring; the copper dome then descends and forces the paper downwards in opposition to the distended cords, which press it into the corrugations of the dome,—a preparatory creasing being given to the outer portion of the paper disc, as it approaches the dome in its descent, by a circular series of moveable horizontal strips of metal, placed on edge near the pulleys and between the cords, and pressed on by a weighted ring. When the heated dome and piece of paper have remained with the cords around them a sufficient time for the paper to dry, the dome is raised, and the corrugated paper-shade released: the shade is subsequently finished by securing a wire around the outer edge, &c., by hand.

In a former paper we noticed a machine for folding pamphlets,—since then a second folding-machine has been brought into the Exhibition. This is the invention of Mr. Birchall, of Ribbleton Hall, Lancashire, and is used for folding the impressions of the *Illustrated London News*, as they are thrown off by Applegath's vertical cylinder printing-machine. In this machine, each fold is produced by a blade (having a to-and-fro movement parallel to itself), which creases the paper or commences the fold, and by a pair of rollers, which serve to complete the fold. The sheet to be folded is laid upon a table beneath a reciprocating blade, which, in its descent, creases the paper along its centre, and causes such creased part to enter between a pair of horizontal revolving rollers. These pass it down between two sets of endless tapes into a suitable position to be acted upon by a second blade and another pair of rollers, whereby the sheet is again folded in a direction at right angles to that of the first fold. In this manner the sheet of paper is folded into the required form,—each fold being, in like manner, produced by a reciprocating blade and a pair of revolving rollers. Although the folding-machine in the Exhibition is supplied with the sheets by hand, yet, in practice, when the printing is effected by a steam-printing-press, the sheets will pass direct from the printing-machine into the folding-machine without the intervention of manual labor.

Mr. W. Marriott, of Leeds Road, Huddersfield, exhibits a machine for packing dry substances (such as chicory, mustard, starch, black-lead, &c.) in paper, printing the labels for such packages, and subsequently pasting the labels thereon. This is a very ingenious contrivance, and one which is likely to be brought into extensive use; for, by simply turning a handle, all the operations, just mentioned, are performed. The substance to be packed is put into a hopper at the top, and descends therefrom, between a pair of crushing-rollers, on to an endless travelling cloth, whereby it is conveyed to a measuring-box, which is of the size required for a packet of a given weight. The measuring-box is provided with two slides, one at the top and the other at the bottom,—the bottom being closed and the top open while the substance is being supplied to the box; but, when it has received the proper quantity, the top slide is closed and the bottom opened; and the dry substance then descends through another hopper or funnel into a paper bag, which has been formed and placed in a mould, in readiness to receive it, by another part of the machine. The paper for making the bags is wound upon a reel at the side of the machine; from the reel it is drawn by a moveable plate (furnished with springs or clips to hold the paper) and conducted beneath a square-sided horizontal bar or mandril; a sufficient length to form a bag is cut off by a pair of self-acting scissors; and then the paper is folded around the mandril by a jointed plate, and the end turned in by three springs,—the edges of the paper having been previously pasted by passing beneath an aperture in the bottom of a paste-box. By means of a rod, connected with the mandril, the paper bag, thus made, is pushed off the mandril into the mould, which is a rectangular iron box, closed at the sides, but open at the ends. The mould being now caused to assume an upright position, the dry substance descends from the above-mentioned funnel into the bag, and is pressed therein by a rammer; and then three sliding pieces fold down the paper at the top of the bag, and thereby form a perfect packet. The mould now returns to the horizontal position, and brings the end of the packet against the end of the mandril; so that the operation of pushing a newly-formed bag into the mould will eject the packet on to a moveable plate, from which it is taken by a pair of sliding-jaws. These jaws hold the packet until it is covered by the label, the paper for which is supplied from a second reel; and the paper is brought under the packet, cut off at the desired length, pasted, and folded over the packet, by similar means to those employed for making the bag. Previous to these operations the label is printed: this is effected by means of a fixed form of types, with a moveable pad above the same; which pad is caused to descend at intervals and press the piece of paper, that is at the moment beneath it, on to the types,—the inking of which is effected, after each impression, by travelling inking-rollers. The packet, when labelled, is released from the sliding-jaws, and carried away by endless moving tapes.

An ingeniously-contrived machine for composing or arranging printing types in the proper order to form words, and for distributing or sorting such types after they have been used for printing, is exhibited by the inventor, C. Sörensen, of Copenhagen. Various machines have, from time to time, been proposed; but, although some at least have possessed the elements of success, there is, perhaps, not one at present in use in this country. Mr. Sörensen's machine somewhat resembles in appearance a small square piano-forte, with a cage or cylinder, about two feet in height and about one foot in diameter, rising from the top of the same, just behind the finger-keys by which the types are selected. This cylinder is formed of narrow upright brass rods, placed at such distances apart as to admit of a row of types being inserted between the adjacent rods; it is divided at about the middle of its length by a flat ring, having as many openings in it (of the same width as the types) as there are spaces between the rods; and the portion of the cylinder above the ring is capable of moving round for the purpose of distributing the types; but the lower part is fixed. The types, to be distributed by this machine, must be cast with small projections at the side (varying with each type); and the openings in the flat ring have corresponding notches formed in the side thereof; so that when the types have been placed in rows between the rods of the top part of the cylinder (with the lowest type of each row resting on the flat ring), and such part of the cylinder is made to revolve, each type will, on arriving at its corresponding opening, fall through the same into the space between the rods of the fixed part of the cylinder; and in this manner all the types of the same letter or character will be deposited in the same space or compartment. The types in each compartment of the lower part of the cylinder rest upon a small metal blade or stop, connected with one of the finger-keys before mentioned. By depressing a key, the corresponding blade or stop will be moved aside, and a type of the desired letter will be permitted to drop into a funnel-shaped receiver (beneath the cylinder), from which it falls through a tubular channel into a grooved composing-stick; and the letters, selected in this manner, may be afterwards spaced out, in the ordinary way, into words and sentences.

Mr. R. Stewart, of Paisley, exhibits an apparatus (invented by Mr. T. Hutchison, of Paisley), by the use of which the designing of patterns in stripes, checks, and tartans, for all kinds of textile fabrics, will be facilitated, the labor of the pattern-drawer dispensed with, and the effect of the pattern in the finished fabric ascertained. The apparatus consists of a square box, through the centre of which a square or four-sided horizontal passage is formed, and lined with looking-glass; and, by a simple arrangement of mechanism, the sides of such passage can be made to approach each other, and thus reduce its dimensions. At one end of the passage a glass screen is fitted, consisting of a square wooden frame, having a plate of ground glass at the back, and a plate of clear transparent glass at the front thereof, with sufficient space between them to receive two thicknesses or layers of strips of colored glass, which are of various widths, and are arranged according to the taste of the designer, so as to produce patterns in stripes, checks, and tartans;—the strips of glass being laid parallel to produce stripes, and at right angles when checks and tartans are required. The other end of the passage is open; and, on looking through from this end, the pattern will appear repeated by reflection in the looking-glasses, and the designer will thereby be enabled to judge of the effect likely to be produced in the finished fabric; for the apparatus displays not only the repeat of the pattern, but the whole breadth and a considerable portion of the length of the fabric at one view. By reducing the size of the passage, part of the pattern can be shut out from the sight, and the effect of the remaining portion ascertained. It is not necessary to paint or draw the pattern on paper, after viewing it in the apparatus; for there are graduated scales at the sides of the open end of the passage, which shew at once the required number of threads of each color, and how many repeats are necessary for the breadth of the web.

Reverting to a very different subject, Mr. Kent, of the Strand, exhibits an apparatus, the invention of Mr. Pruday, for reducing substances into small particles for the manufacture of soups, &c. This apparatus, which is a substitute for the "tammy cloth" used by cooks, consists of a semi-cylindrical sieve, formed of wire-gauze or perforated sheet metal, and furnished with wooden ends. The sieve is closed at the top by two hinged flaps, and fixed in the upper part of a square wooden framing. A shelf is provided below the sieve to support a pan, designed to receive the matters that pass through the meshes of the gauze. The ends of the sieve form bearings for the pivots of a small swinging frame, which carries a bar or brush that works in contact with the semicircular bottom of the sieve,—the motion being given to the frame by a handle, with which it is provided at its upper part. The meat and vegetables to be operated upon, having been prepared by stewing or otherwise, are put into the semi-cylindrical vessel, and the flaps shut down. The operator, by means of the handle, swings the frame to and fro, and causes the bar or brush, which it carries, to rub the solid matters against the wire-gauze or perforated metal, until they are reduced by attrition into small particles, when they will fall from the sieve into the pan below, in a state suited for the making of soup or similar semi-fluid culinary matter.

Mr. Kent likewise exhibits an apparatus for sifting cinders, consisting of a cylinder of perforated sheet metal, which is mounted in an inclined position within a close wooden case, and is rotated by means of a handle on its axle. The ashes and cinders are introduced through a hopper into the upper end of the cylinder; and, as it rotates, the ashes fall through the perforations into the bottom of the case, while the cinders are discharged at the lower end of the cylinder into a hooded vessel, which is suspended in front of the discharge—opening in the end of the case.

Another rotatory cinder-sifter is contributed by Mr. J. M. A. Bishopp, Canterbury-row, Kennington-road. In this apparatus, the body of the sifting-cylinder is formed of stout wires, extending from end to end, with narrow spaces between them; and one portion thereof is formed into a door, through which the ashes and cinders are introduced. The cylinder is mounted in a horizontal position in the upper part of the wooden case, and beneath it there is a funnel or hopper, through which the ashes, as they fall from the cylinder, are conducted into a leather bag. When all the ashes have been separated from the cinders, the rotation of the cylinder is stopped, and the door in the body thereof is opened; and the cylinder is then turned, to bring the opening over the mouth of a shoot in the side of the case, down which the cinders are discharged into a suitable receiver.

Whilst treating of sifting apparatus, we must not omit to notice a neat little machine for rapidly sifting fine powders, exhibited amongst the goods from the Zollverein States by E. Gressler, of Erfurt. It consists of a three-sided drum or prism, the sides of which are formed of fine horse-hair sieve-cloth,—one side being hinged, for the purpose of introducing the powder to be sifted and withdrawing the residue. The drum-ends are of wood, and carry metal pivots, which turn in bearings in the ends of the box or case that encloses the drum. One of the pivots projects through the box, to receive a handle, by which the drum is caused to rotate. Besides this rotatory motion, an endwise or shaking movement is imparted to the drum by means of a disc or wheel, with five projections or steps upon its face, which is also fixed upon the pivot that carries the handle. By the rotation of the drum the projections or steps are successively brought into contact with a curved piece of metal, fixed on the end of the box,—the effect of which is to give the drum a movement endwise; and, as the projections pass the curved piece, the drum is forced back in the opposite direction by a spring, which presses against the back of the disc.

A lint-making machine, exhibited by Mr. H. Searle, of Hoxton Old Town, may be noticed as an example of the application of machinery, actuated by manual power, to economize labor in the performance of a simple operation—that of scraping linen fabric, so as to raise a nap or woolly surface thereon; but it must not be looked upon as the most perfect machine of its kind; for, within the last two or three years, some improved lint-making machines, actuated by steam power, and capable of producing a superior description of lint, at little cost, have been brought into use; but they have not found their way into the Exhibition. In the machine under notice, a straight blade or knife, fixed across the end of a vibrating lever, exerts a kind of chopping or scraping action upon the surface of the linen fabric (which is supported by a leather cushion): this action, by raising the outer fibres, forms a kind of nap upon the fabric; and thus the material known as lint is produced. The lever carrying the knife turns upon a pin or axis at its hind end; it is suspended at the front end by a cord attached to a spring; and there is another spring which acts beneath this end. The lever is drawn downwards, in opposition to the action of these springs, by the workman depressing a treadle, connected with the lever by a strap; and it is raised again by the springs.

A useful application of well-known means is exhibited by Mr. J. P. Nevill, of Crutched Friars, London, in the form of a model machine to be placed in a ship's hold for the purpose of economizing labor in the discharge of loose cargoes (such as corn or coal) and ballast. The operating part of the machine consists of an endless chain of scoops or buckets, which passes over rollers, one at the top of the machine, above the deck, and the other at the bottom, below the surface of the cargo in the hold. The endless chain being put in motion by a winch-handle or other suitable means, the scoops or buckets descend in succession beneath the lower roller, take up the corn or other matter, and carry it to the top of the machine; whence it is delivered down a shoot into a suitable receptacle. When the machine is used for discharging corn only, the buckets are intended to be made of a suitable size for measuring the corn at the time of discharging it.

A machine for performing the work of the gold-beater, or the most laborious portion of that work, is exhibited by Messrs. Vine and Ashmead, of Hartford, Connecticut, U.S.: it is termed, by them, the automatic gold beater. It consists of an anvil or iron platform, on which a square iron frame is placed, having a wooden bottom, with a square opening in it (covered by a flap of parchment) to receive the packet of membrane and gold intended to be submitted to the operation of beating; which is performed by a large hammer, actuated by rotating cams or tappets, in a similar manner to the ordinary tilt hammer. In order that every part of the packet of membrane and gold may be acted on by the hammer, a traverse motion is imparted to the iron frame by means of four upright levers, set one against each side of the frame. The levers vibrate on fulcrum pins at their lower ends; and their upper ends, which are slightly bent or curved inwards, similar to the jaws of a vice, bear against the sides of the frame. The levers act in pairs; one of each pair being pressed against by an excentric, at about the middle of its length, the frame is pushed in one direction; and the return movement of the frame is produced by a spring, consisting of a strip of brass, curled spirally around the axis of an arm, which carries at its upper end a small roller that acts against the opposite lever of the pair. Each pair of levers is provided with five excentrics of different dimensions, mounted on the same shaft; and the excentrics are severally used according to the extent of motion desired to be given to the iron frame.

. Of late years various schemes have been proposed for adapting machinery to the cutting-out of materials for making up into gloves. M. Senechal, of Belleville, near Paris, exhibits a machine for this purpose, acting in the manner of a roller press. The knives or cutters are fixed upon a metal plate, in suitable positions for effecting the different cuts required to form the fingers and thumb-hole. The cutter-plate is placed upon a sliding tray; several thicknesses of the leather or other material to be cut are then laid upon the cutters, and a piece of stout sole leather placed thereon; and the whole is then introduced between a pair of rollers, by the pressure of which the cutters are caused to pass through the several thicknesses of material, and thereby cut the same into the desired shape.

Our description of this machine may be appropriately followed by a notice of a machine for cutting-out leather for making boots and shoes, exhibited by M. Dumerey, of Paris. In this machine, the piece of leather to be operated upon is laid on a moveable platform or board, which carries it beneath a punch, the cutting-edge of which corresponds with the shape the leather is intended to assume. The punch, or cutter, is provided with a piston for preventing the severed piece of leather from adhering to the edges of the cutter. Between the successive descents of the cutter, the platform or board moves onward a short distance, in order that, at the next descent of the cutter, it may act upon a fresh portion of the leather. This machine forms one of a series of seven or eight employed at Paris in the manufacture of "screwed boots and shoes," or those in which the soles are secured to the upper-leathers by screw rivets. The only other machine of this series which has been sent to the Exhibition is one for performing the operation of "blocking" the backs of boots.

Mr. Mansell, of Birmingham, exhibits a fly-press for cutting-out pieces of leather and other materials into suitable forms for making various articles, such as boots, gloves, &c. Steel tools, or punches, of a proper shape, are fixed to the screw of the press; and the bed of the press, whereon the leather or other material is laid to be cut, is made of steel: by this means the operation of cutting-out is performed with great accuracy.

The preceding notices of machines for cutting-out leather and other materials naturally lead to the consideration of the mechanical means proposed to be substituted for hand-labor in the operation of sewing. Of this class of machinery there are several examples. We shall commence with the most simple form of apparatus, which is one made by Messrs. W. & C. Mather, of the Salford Iron Works, for sewing or running together pieces of calico previous to dyeing, for sewing sacks, &c. It consists of a small pair of toothed wheels, placed one above the other, with their teeth interlocking; and around the edge of each wheel two grooves are made, coinciding with the grooves in the other wheel, and forming an opening suitable for receiving the point of a needle. The two thicknesses of fabric to be sewn are introduced between the toothed wheels, which being caused to revolve, crimp the fabric, and press it on to the point of a threaded needle, fixed in an adjustable bracket, with its point in the opening formed by the grooves. When the whole of the fabric has been gathered on to the needle in a crimped or corrugated state, the sewing is completed by drawing through the needle. In some cases, two needles may be used, one for each pair of grooves, so as to produce two rows of sewing at the same time.

A machine for sewing coarse linen cloths, sacks, &c., is exhibited by M. Senechal, of Belleville, near Paris. In this machine, as in the preceding one, the sewing is performed with a needle of the usual form; but, in the former instance, the needle remained stationary while the fabric was pressed on to its point, and, after it had been drawn through, the thread appeared in short lengths on either side of the fabric alternately (in the manner of what is commonly known as "running" or "basting"); whereas, in this case, the needle is passed through the fabric from one side only, and after each time of passing through, it is carried back over the edge of the fabric, in the same manner as "felling" is performed by hand. The two thicknesses of cloth to be sewn are attached at the edge to an endless moving band, which carries the same to the part of the machine where the needle works. The needle, which is threaded with twine, is carried by two pairs of self-acting metal pincers, one near each end thereof. On the point of the needle entering the cloth, the first pair of pincers opens and rises from the needle, which is pushed onwards by the second pair; and when the needle has passed about two-thirds through the cloth, the first pair of pincers again seizes it, and draws it completely through the cloth,—the second pair at the same time opening and leaving the needle free. After the needle has passed through the cloth, the second pair of pincers again takes hold of the needle, and aids the other pincers in carrying the needle back over the edge of the cloth into its original position. The twine or thread is kept distended, during the movements of the needle, by means of two moving metal rods or arms, which also serve to draw the stitches tight.

Mr. Judkins, of Manchester, has a machine for stitching two thicknesses of fabric together. The fabric is carried by a rack-bar, which is moved forward a given distance for every stitch. Two threads are employed. One thread is carried by a needle, which has an eye near its point for the reception of the thread, and is fixed to the eye of a bent arm, having a reciprocating movement, so as alternately to pass the needle through the fabric and draw it back again; the return movement of the needle forms the thread on the inner side of the fabric into a loop, through which a shuttle then passes, carrying the other thread; this second thread prevents the loop from being drawn out through the hole by which the needle entered; and by a succession of such movements of the needle and shuttle, a row of stitches is formed, presenting, on the outer side of the cloth, a similar appearance to a row of stitches made by hand.

In the French department, M. Magnin, of Villefranche, Rhône, exhibits a machine, which he calls "*cousobrodeur*," for sewing and embroidering fabrics, and also for making cords and plats. In this machine, the fabric to be sewn or embroidered is placed upon a table, beneath an upright needle, and over a small hole in the table; and the fabric is moved by the attendant beneath the needle in suitable directions to produce the desired lines of sewing or embroidery.

In the side of the needle, close to the point, is formed a notch or hook, so that it presents a similar appearance to the needles now used for "crochet-work:" the use of this hook is to catch hold of the thread, when the needle descends through the fabric and through the hole in the table (which it is caused to do by the action of a treadle, worked by the foot of the attendant), and to draw such thread upwards through the fabric, when the needle rises again. The thread is wound upon a bobbin beneath the table, and passes therefrom through the eye or guide of a thread-carrier, which is caused to revolve in either direction alternately, for the purpose of winding the thread around the stem of the needle, and thereby preventing the hook from missing the thread. Upon the stem of the needle there is a nipple, affixed to a sliding tube, and capable of moving independently of the needle;—its office being to press upon the fabric and hold it firmly while the needle is passing through it. At the commencement of the operation of sewing, the thread is conducted from the bobbin through the guide of the thread-carrier, then upwards through the hole in the table, and is fastened to the table beneath the fabric. The needle and nipple now descend,—the former passing through the fabric, and the latter preventing the fabric from moving; by the revolution of the thread-carrier the thread is wound around the stem of the needle in such manner that, as the needle ascends, it will slip into the hook or notch thereof, and be drawn upwards through the fabric in the form of a loop; and at this time the nipple rises from the fabric, and the thread-carrier returns to its first position. The attendant now moves the fabric to an extent equal to the length of a stitch; the needle, again descending through the fabric, passes through the loop, which it leaves upon the fabric; and, on re-ascending, it draws a newly-formed loop through the preceding one. In this manner each succeeding loop is drawn through the preceding loop, in a similar way to the common stocking-stitch for making plain hosiery; and fabrics of any texture, from muslin to woollen cloth, may be thereby sewn together or embroidered,—the direction of the line of stitches being regulated by the operator. If there is no fabric upon the table, the machine will form the thread into a cord or plat.

Somewhat akin to the foregoing is a machine invented by M. Croisat, of Rue de Richelieu, Paris, in which a fine crochet-needle is employed, in like manner to the above, to make wigs, or "to implant hairs in silk and other kinds of tissues." A piece of pink or flesh-colored silk, of a suitable sise for forming a wig or scalp-piece, is stretched in a horizontal position, by means of cords at each side, over a mass of hair, which, together with the silk, is supported by a moveable frame or carriage. This carriage traverses across the machine beneath a fine crochet-needle, which is worked rapidly up and down; at each descent it passes through the silk and catches hold of a single hair, by means of its hook; and, on ascending, it draws the hair through the silk in a looped form. At each traverse of the carriage, a row of looped hairs is formed on the surface of the silk; then, before the carriage returns, the several looped hairs are combed out straight; and at those parts where the hairs have not been drawn through by the reciprocating needle, a crochet-needle is used with the hand to remedy the deficiency. It should be remarked, that the hairs are securely fastened at the root-end beneath the silk, whilst the other part projects through it. With this little tribute to vanity, our review of what we have, perhaps somewhat arbitrarily, termed "labor-saving machines," is concluded.

DECORATIVE ART.

In our last paper we treated of the applications of gold and silver to art manufacture. We now pass on, in continuation of the subject of art manufacture in the metals, to the considerations connected with the adaptation of the so-called baser metals to ornamental purposes. Here, however, we must not forget that, in the application of a material to the purposes of decoration, the nature and appearance of the substance itself may be a matter for secondary consideration; the amount of art employed in bringing it to the desired ornamental condition, being the only criterion by which it can be judged of. Under some circumstances,—that is, when applied to particular kinds of ornament, the color of a metal, as that of gold or silver, may, perhaps, tell advantageously; but this is not generally the case with metallic decorations,—as we observed in the last paper, form is here the great point to be considered; and although, by particular treatment of the surface of the metal, the forms of the artist's work may be more completely developed, and the effects heightened to the improvement of the appearance of the whole design, such treatment cannot be looked upon as positively essential, being, indeed, an accessory, and, not like color in a picture, an indispensable element under ordinary circumstances.

If we pay a little attention to the applications of art to manufactures in metal, we shall perceive that there is no branch of art manufacture more deserving of culture, or requiring more study for the attainment of success. When color is introduced as an element of decoration, the artist possesses a powerful instrument which, handled with judgment and skill, will serve to render many defects of design less glaring than they would otherwise appear; the effects of harmonious coloring are so pleasing to the eye, that imperfections of form, which would, in the absence of color, stand out prominently, are hidden or passed over without exciting a disagreeable impression in the mind of the spectator. This cannot, however, be the case where, as in common ornamental metal work, everything depends upon form. The attention is, under such circumstances, directed exclusively to the design; the artist has no chance of escape from unfavorable criticism but by studying closely the legitimate end of his work, and by maintaining scrupulously that unity of effect and suitableness of purpose, without which all his efforts must ever prove insufficient. There is perhaps no branch of decorative art in which we encounter greater incongruities, and perceive more strikingly the absence of fixed principles, than in that of which we are now treating; and this is the more to be regretted, because there is no manufacture in which England shews to so great advantage, in respect to manual skill and mere workmanship.

There certainly is no other country which could produce such a collection of ornamental metal work in iron, steel, and brass, as that exhibited in the Crystal Palace; but we are compelled to acknowledge that the same want of artistic training, which may be traced wherever we attempt to unite art and manufacture, exists here in all its strength.

The art of working in metals differs in many respects from other subjects in which artistic designs have to be reproduced. This is particularly the case in that manner of producing metal ornament in which the effect has to be achieved by hand, as in works of wrought iron and brass. A great distinction must therefore be drawn between works of this class and those in which the object is reproduced by casting in a mould. The first is the work of one who is, or at least who ought to be, somewhat of an artist in feeling, if not by education; the second is that of a workman skilled only in the technical process of casting, which bears no relation whatever to the work of the artist, in an artistic point of view. Neither, as we have remarked before, does the nature of the material relate in any way to the question of art in this case: the only object is the employment of a metal which is capable of interpreting, with fidelity, the form and spirit of the work. From the peculiar properties of certain metals, however, they are unsuitable to the purpose of reproducing artistic works; this unsuitableness may arise from several circumstances, as we shall presently shew.

The art of casting certain metals, with the highest degree of success, was known to the ancients. They were well acquainted with the properties of the alloys of copper and tin; and although they had probably not obtained the metal zinc in its isolated metallic state, they knew it in chemical combination, under the form of calamine, from a mixture of which substance and copper they manufactured brass. It has been supposed that they were acquainted with some peculiar process of producing bronze, or mixtures of copper and tin, which is said to have possessed the hardness of steel; but analyses of antique bronzes have thrown no light upon this statement, which seems, indeed, not to have a better foundation than a hundred others respecting the works of people long passed away. At all events, the art of casting in bronze was practised hundreds of years ago; but casting in iron is a process of comparatively late date. The smelting of this refractory metal, to a sufficient degree to render it perfectly fluid, so as to be capable of insinuating itself into the recesses of an intricate mould, is an operation which requires many scientific appliances with respect to the construction of the furnace, and the command of a powerful fuel, both of which were beyond the reach of the ancients. Even in the days of mediæval art, when ornamental metal work was so universally employed, wherever iron was used it was wrought by the hand. This circumstance served, no doubt, to give to the beautiful designs of that period much of their peculiar character. Great weight and solidity were avoided, of necessity, from the difficulty, if not impossibility of producing intricate patterns in so stubborn a material as wrought iron, when worked solely by the hand, and without the aid of machinery of any description. It was necessary that the design should be of a character which would admit of a certain degree of lightness and slenderness in the rods of metal to be worked up; consequently, the characteristic peculiarity of early works of this class consists in the elegance of the tracery; and the graceful twinings of climbing plants seem to have generally suggested the idea of the forms to the workman or designer. An adherence to some standard form seems to mark the decorative style of all periods; and it is probable that a close analysis of the subject would go to shew, that in all, however greatly modified they may be, the purity of the style is only maintained so long as that standard form constitutes the basis of the work. The forms of the vegetable kingdom have furnished materials for the artist in almost all cases; and it is far from mere speculation to suppose that the peculiarity of the plants of a clime may have influenced, in great measure, the style of its ornament, and even of its architecture.

The ancient Egyptians possessed their lotus, the elegant lily of the Nile,—the Greeks their acanthus: what the lotus was to the Egyptian and the acanthus to the Greek, that the grape vine and the ivy was to early ornamental art in England. The introduction of these plants into their decoration, marks distinctly the works of the earlier mediæval artists of this country, and may be found not only in wrought iron and brass ornament, but likewise in the traceries of the backgrounds of stained glass windows of the twelfth and thirteenth centuries. Although we have, since this period, improved in manipulative skill, we have made no advance in the appreciation of the principles of art—that is of ornamental art; and although we have had all the advantage of six or seven hundred years of experience, and possess increased facilities of every kind, we are content to go back to that remote period for our designs and manner of decoration of a certain class of art manufactures. Thus, if, as a shrewd author has said, "imitation is the confession of inferiority," we are tacitly acknowledging our inferiority to a people whom we are accustomed to regard as comparatively uncivilized. The wrought iron and brass work of the early style presents us with a striking example of a fact already mentioned, viz., that ornament may be almost entirely independent of the material in which it is executed. In ornamental work of iron and brass the appearance of the metal lends no accessory beauty to the design; it possesses neither color nor brilliancy of surface to charm the eye; the variety of effects so easily obtained with gold and silver are wanting here; and indeed, in this respect, the ancient craftsman seems not to have had the art of availing himself of all the capabilities of the metals he used. There is neither burnishing nor matting; the metal is left almost in its normal state; and yet these works are models of general elegance of effect when compared with modern ornamental art. There are some beautiful specimens of metal work in the exhibition, executed in the early mediæval style, and which, with regard to workmanship, far exceed the works of that period; but these are, unfortunately, isolated examples, and are professedly copies of the manner of a particular epoch. One of the most elegant specimens will be found in No. 34, Class 22, in an entrance to the English hardware department; this is a beautifully wrought iron gothic hinge, appropriate and chaste in design, and of very fine workmanship; it is ornamented with branches of ivy, with leaves and berries; it is altogether deserving of admiration. The design is by Farmer—the execution of the work by Barnard and Bishop. Another good example of wrought iron work of the style of the mediæval period, is the iron railing enclosing the large hall stove, exhibited by Hardman and Co., in the Mediæval Court. This railing exemplifies the style of the time, and likewise the manner of fixing and arranging the parts of the work; it is a good example of delicate tracery, and fully bears out the remark that the origin of designs of this class is derived from the graceful intertwinings of the tendrils of plants. Before we leave this part of the subject we must also direct attention to the wrought brass chandeliers and candelabra: one of the chandeliers is remarkably good, both with respect to the forms and appropriateness of the ornament. We cannot refer to it by number, but it will be easily recognized, as hanging near the southern wall of the Mediæval Court. Another good specimen of design in wrought brass may be seen in the doors of the cabinet containing church plate. This brass work and the chandeliers are also by Hardman, of Birmingham, as indeed is all the metal work in this collection.

Probably no person would be so injudicious as to desire that, at the present time, we should return to the exclusive manufacture of works of the class we have just described; such a step would not only be impossible, in a commercial point of view, but would be undesirable even as a question of art. As we have remarked in our earlier papers, it is not by fostering a slavish imitation of previous styles, that any true progress can be made in the cultivation of the art of decoration; but, by making ourselves thoroughly acquainted with what those who have gone before us have achieved, and by endeavouring to learn, by careful analytical enquiry, the principles that guided them, we may be able to collect a mass of elementary information, out of which may be constructed a system of ornamental art, founded upon correct and fixed principles, and which would be consequently as pure as any ancient style, and, at the same time, possess the advantage of being more adapted to the peculiarities of a later age.

At the present day, the resources of ornamental metal work are increased to an almost unlimited extent by the perfection to which the art of casting in metals has been brought. As a medium for the interpretation of art, cast metal possesses great advantages over that wrought by hand. In wrought works, the unyielding nature of the metal, from which the design is to be formed, must always exercise an influence over the style and extent of the work, limiting both the size and the intricacy of the pattern; but such is not the case where the metal is cast,—as, when the mould is once made, an intricate and difficult pattern is cast with as much ease as the simplest object; we shall perceive, that the extent of the pattern must be great indeed which could present an insuperable obstacle in casting, when we learn that each of the four great leaves of the elegant cast-iron gates, made by the Coalbrookdale Company, was cast in one single piece. There is, however, one circumstance of importance to be considered, with respect to casting in metal; this is the capability of the metal to receive a perfectly sharp and true impression from the mould. Metals differ very much in this respect; and the following is one of the reasons of this difference:—All bodies possess the property of increasing in bulk under the influence of heat; and this expansion, as it is termed, is a growing quantity in proportion to the increase of temperature; upon cooling, the additional bulk which the metal had gained during the process of melting, again vanishes gradually,—the mass of poured metal becoming less and less, until it reaches its normal or specific size. This *gradatim* diminution of bulk, under depression of temperature, takes place in almost all substances; but there are exceptions to the law. Into the cause of this we will not stop to inquire. It is sufficient, in connection with our present subject, to know, that amongst the metals, iron, bismuth, and antimony, do not follow the law of progressive contraction in cooling. These metals, on the contrary, after gradually contracting with the lowering of the temperature down to the point at which they pass from the fluid to the solid state, experience at that point a sudden expansion or increase of bulk. During this change, the metal is again forced into the interstices of the mould from which it had partially receded; thereby giving a perfectly sharp and faithful copy of the original work from which the mould was made. It is owing to this remarkable property that iron is so peculiarly suitable to certain forms of fine casting; and in spite of its apparent intractability, there is no other metal from which the wonderfully delicate ornamental castings which may be seen in the Zollverein and Prussian departments of the Exhibition, could be produced.

It is also owing to the property which we have just described, that alloys of antimony are so well adapted to the casting of printing types, in which the most excessive delicacy and perfection of surface is required, in combination with a certain amount of hardness. It is not, however, the property of expanding at the moment of "setting," that must alone be considered in respect to metal founding. The mixtures of copper and tin, termed bronze, do not possess this property; nevertheless, the very finest castings can be produced from bronze, simply because this metal becomes so remarkably fluid, when molten, that it is capable of entering the most minute recesses of the mould. Some metals are also readily attacked by the oxygen of the air at a high temperature; the surface of the molten mass becoming covered with a coat of the oxide, which interferes with the process of casting: this action is so strong with zinc, that the metal quickly becomes clotted, and thereby loses its fluidity to a very considerable extent. In preparing mixtures of copper and tin for casting in bronze, it is a great object to produce a compound which best resists this oxidation; and the property of being but little affected by oxygen is one of the chief causes of the suitability of bronze for fine art castings. Owing to its oxidizable nature at a high temperature, lead is as unsuitable as zinc for fine casting; although, from its property of melting readily, added to its cheapness, it may perhaps be advantageously used for coarse works, to be viewed only from a distance.

As specimens of iron casting of the very finest character, we refer to a casting of armorial bearings by Bramah & Co., and to specimens of casting by Hoole, of Sheffield; these are as they were taken from the mould,—the sand being merely cleaned off. In the foreign department, we may direct attention also to the cast-iron ornaments from Berlin, and to a fan from Augsburg.

The art of casting in metals of every kind must, as respects our subject, be regarded merely as a technical means applied to the service of ornamental art. The quality of the casting itself it is not our province to consider, excepting so far as the suitableness of the metal, as a medium for the interpretation of certain works of decoration, is concerned. The artistic part of the subject must have been completed before the casting was commenced; and it is only in the preparation of the design that art, properly speaking, can be shewn.

Perhaps it would be difficult to write upon any subject in which illustrative examples are so abundant as in the present instance. We enter the hardware department of the Exhibition, and chandeliers and candelabra, stoves and grates of all kinds, surround us on every side. These are in the very highest style of modern decorative art; yet we consider that, generally speaking, they prove beyond question the truth of our foregoing remarks. The specimens to which we more particularly allude are the grates, the mere workmanship of which is all that could be desired; the processes of polishing, burnishing, chasing, and lacquering, are all executed to a marvel; but yet there is a sad falling-off with respect to the question of art. Ornaments of the most incongruous kinds are jumbled together; the apparent object and sole desire in many cases having been to cover space, and fill up any vacant corner, without reference to the fitness of the parts to associate with each other. Thus we find a Renaissance or Louis Quatorze stove fitted with great profusely ornamented dogs, the only use of which is to hide the ornamental panels of the stove itself. It is but a few days since that we saw in a private drawing-room a very expensive grate of polished steel, of Elizabethan form, the ornaments being wreaths of oak-leaves arranged in the perpendicular style; but the artist, not satisfied with his oak-leaves, had introduced a large Etruscan ornament upon two pilasters at the sides of the fire-place.

Such inartistic mixtures of ornament arise naturally out of the circumstance that our designers have no fixed principles to guide them, and also from manufacturers being too ready to give way to the bad taste of many of their customers. In spite, however, of some instances of the short-coming of art in these works, there are many to be highly praised for the chasteness of design, while others display that appropriateness of pattern and unity of effect which must ever be the leading principles in decoration.

It is impossible to mention all the specimens which we consider worthy of attention, but we subjoin a few names, among whose contributions the best will be found;—Messrs. Pierce and Co., Feetham and Co., Stuart and Smith, Hoole, of Sheffield, and Bailey and Sons, &c.

Leaving the stoves and grates, we examine the other branches of ornamental metal work. Some of the articles in or-molu are extremely well designed and executed; and we must not forget here to mention a brass lectern, designed by

Cottingham, for Hereford Cathedral; this is in the style of the mediæval period. There is also a good specimen of cast-iron railing, in the Roman style, by Longdon and Co., and another in the Italian style, by Bailey and Sons, in the Fine Art department. The fine cast-iron gates already mentioned as the work of the Coalbrook-dale Company, and placed in the Northern Transept, demand here a word of commendation. The gates in the Southern Transept, by Cottam and Hallen, are perhaps equally good; both being indeed admirable specimens of a combination of art and manufacture.

On the foreign side there is but little worthy of attention in the ornamental metal work for decorative purposes only, if we except the or-molu works in the French department, some of which are very good, and the most western of the great Russian candelabra.

The fact is, that England could, owing to her great mechanical skill, and many natural advantages, readily take and maintain the lead in metal work of this kind, as she has done in that of a different description; the only thing necessary to this end being, that training which some other nations have been sufficiently prudent to secure for those who devote themselves to the service of art-manufacture. We trust that the Exhibition will have at least the effect of awakening Great Britain to a sense of her deficiences in this respect, and of exciting fresh efforts to bring the educated artist and the artizan into that inseparable connection without which the decorative arts can never attain to a flourishing and vigorous existence.

RECENT PATENTS.

To Charles Roper Mead, *of Charlotte Cottages, Old Kent-road, in the county of Surrey, mechanical engineer, for improvements in apparatus for measuring gas, water, and other fluids.*—[Sealed 21st January, 1851.]

This invention relates, first, to an improved arrangement or construction of the parts of a wet gas-meter, whereby the measuring may be effected with one gas-vessel. The second improvement is a modification of the first; but, in this instance, two measuring vessels are employed; with this exception, however, the principle upon which the meter is constructed is very similar to that of the meter with a single measuring vessel. In meters constructed according to these improvements, the measurement of the gas is not affected by any variation in the height or quantity of the water in the meter. The third improvement has reference to the counting apparatus of a meter for measuring gas, water, and other liquids. The last part of the invention relates to improvements in the construction of meters for measuring water or other liquids.

In Plate IV., fig. 1, is a front elevation of a meter, constructed according to the first part of the invention,—the front plate being removed, to shew the internal working parts more clearly; and fig. 2, is a side elevation of the same; fig. 3, is a front view of the gas-vessel; fig. 4, is a side elevation of the valve-seat and gas-pipes; and fig. 5, is a plan thereof. *a*, is a vibrating metal chamber, divided into two compartments, into which the gas-pipes *b*, *b*, respectively project; the other ends of these pipes are connected to the horizontal pipes *c*, *c*; and the latter are firmly fixed to the valve-seat *d*. In the valve-seat there are three openings, the centre one of which is in connection with the gas-passage *e*, and the side ones with the pipes *c*, and *b*. The gas enters the meter at the pipe *f*, thence it passes down the pipe *e*, and, according to the situation of the valve *g*, it is directed into one end or compartment of the measuring vessel *a*. The gas will raise that end of the measuring vessel into which it is admitted, and thereby cause one of the projecting pieces *n*, to act on the roller *o*, and throw it and the lever *i*, to which it is attached, forward; the tail of the lever *i*, will, at the same time, act upon the valve *g*, and shift its position: whereby the supply of gas will be cut off from the pipe down which it was proceeding into one compartment of the measuring vessel; and the pipe which was conducting the gas from the opposite compartment of the measuring vessel will become the feed-pipe for the gas to its compartment. *h*, *h*, are weighted levers, so adjusted as to support the tumbling-lever *i*, when it has fallen into such a position as to have shifted the valve *g*, to its required situation; and these weighted levers, by reason of their tendency to return to a vertical position, also assist the gas-vessel in lifting the tumbling lever from such positions as require the most power to move it.

The patentee claims, under this head of his invention, supporting or counter-balancing the tumbling lever by a mechanical arrangement, which assists in lifting it to a vertical position: whereby the resistance offered to the gas, in working the meter, is greatly reduced.

In order to register the amount of gas passed through the meter, a rod *j*, is jointed to a piece of metal, which projects from the top of the gas-vessel; and this rod is attached to a lever *k*, which is connected by a wire *l*, with another wire that works in a tube *m*. The upper end of the tube enters the index-box, and the lower end is carried below the water-line, in order to prevent an escape of gas into the index-box. The upper end of the wire that works in the tube *m*, is connected to a short lever carrying a click, which acts upon the teeth of a ratchet-wheel belonging to the train of registering or counting-wheels; so that every time the wire is caused to ascend in the tube, by the movement of the vibrating chamber *a*, it will give motion to the registering or counting-wheels.

Fig. 6, is a front elevation of a meter with two gas or measuring vessels,—the front plate being removed, to shew the valves and internal parts; fig. 7, is a side view of the same; fig. 8, is a front view of one of the gas vessels; fig. 9, is a side view of the valve-seat and gas pipes; fig. 10, is an end view; fig. 11, is a plan or horizontal view; and fig. 12, is a section of the same. *a*, *a*, are the two vibrating measuring vessels, each divided into two compartments, as before, into which the ends of the gas-pipes *b*, *b*, respectively project; and the other ends of these pipes are connected to the horizontal pipes *c*, *c*, by which a communication is formed with the valve-seat *d*. The valve-seat has six openings,—the two centre ones being in communication with the gas passages *e*, and *f*, and the side ones with the pipes *c*, *c*. The gas enters the meter at the pipe *f*, thence passes down the pipe *e*, and, according to the situation of the valves *g*, *g*, enters two of the pipes *c*, from whence it passes to the pipes *b*, *b*, and finds its way into one of the compartments of each measuring vessel. The gas will raise the ends of the measuring vessels into which it is admitted, and thereby cause the connecting-rods *h*, *h*, to operate upon the crank *i*, (fig. 7,) and cause it and its shaft *j*, to revolve. On the front end of the shaft *j*, is a worm *k*, having a small crank-pin in the face thereof, which communicates with the valves *g*, *g*, by means of the connecting-rods *l*, *l*, and the levers *m*, *m*. This crank-pin is so arranged that it will shift the position of the valves as soon as the compartments of the measuring vessels become filled with gas: by which means, a certain quantity will be measured, and a uniform supply kept to the burners.

The patentee claims the application to wet gas-meters of two or more vibrating measuring vessels,—communicating motion through one or more revolving shafts to two or more slide-valves, as above shewn and described.

In order to register the amount of gas passed through the meter, the worm *k*, (fig. 6,) works into the worm-wheel *n*, on a spindle *r*, that passes through the stuffing-box *o*. The opposite end of this spindle is furnished with a small endless screw or worm *p*, for giving motion to the registering or counting wheels.

The improved counting apparatus consists principally of a row of drums or wheels, carrying figures on their periphery, and mounted upon one common shaft. These drums or counting wheels are actuated in such a manner that they only move when the figures are to be changed. A worm-wheel *q*, is affixed to the first drum, and driven by an endless screw or worm *p*. This motion is communicated to the drums by means of spring-catches, somewhat after the ordinary manner of working counting apparatus. The first drum is considerably wider than the others, and carries two rows of figures on its periphery. The first row consists simply of ten 0's and ten 5's, arranged alternately around it; and the second row consists of a duplicate series of numerals, extending from 0, to 9, and arranged thus:—1, 1; 2, 2; 3, 3; 4; and so on;—therefore, at starting, the figures presented by the two rows at the openings in the index plate will be 00; next 05; then 10; next 15; and so on. The second and third drums have each a single series of figures from 0, to 9, extending around them. Every drum, except the first, has a ratchet-wheel; and every drum, but the last, is provided with a catch. The catches are so arranged that, when the respective drums, to which they are attached, have made nine-tenths of a revolution, they pass under stationary springs, which force them into contact with their respective ratchet-wheels, and thereby cause the drums, with which the ratchet-wheels are connected, to advance one-tenth of a revolution. When a catch has passed the stationary spring, it will be lifted by its own spring clear of the ratchet-teeth. By this arrangement, each drum becomes the driver for the next; and, when the drum to the right has made ten revolutions, the second will have made one, and the third one-tenth of a revolution.

The patentee claims the method herein shewn and described of arranging and actuating a series of drums or wheels, having figures on the circumference,—such wheels or drums being placed side by side in such a manner that the quantity of gas, water, or other fluids, passed through the machine or meter, may be thereby ascertained with facility.

Fig. 13, is a front elevation of the meter for measuring water or other liquids; and fig. 14, is a section of the measuring vessel. A, is a vibrating measuring vessel, divided into two compartments by the partition C, and furnished with two buckets *g*, *g*, firmly fixed to it. B, is a receiver, having a long opening in the bottom for changing the cylindrical stream which issues from the supply-pipe D, into a flat stream. E, is the discharge-pipe. The water or fluid to be measured is conducted by the pipe D, into the receiver B, whence it falls on to one end of the measuring vessel, until a sufficient quantity has collected to overbalance or tip over that end; the relative positions of the two ends will then be changed,—the water or fluid being discharged, and the opposite end of the measuring vessel brought into a position to receive the entering fluid, which is directed into either end of the measuring vessel by the partition C, which falls, with the measuring vessel, into such a position as to direct the fluid into the more elevated compartment. The quantity of fluid discharged at each vibration of the measuring vessel is regulated by the small stops *f*, *f*, which determine the angle of its vibration. To ensure greater certainty in the tipping over of the vessel with the required quantity of fluid, two small buckets *g*, *g*, are attached to the measuring vessel, in such a manner that the last portion of the fluid that flows into the vessel to be measured, previous to tipping over, runs into them: whereby its weight is brought to bear with the greatest effect upon the measuring vessel. To register the quantity of fluid passed through the meter, an index is attached, which is operated upon at every vibration of the measuring vessel.

The patentee claims the use of a vibrating vessel, having buckets at each end to assist in tipping over the same, and a partition in the centre for changing the direction of the liquid from one side to the other of the vibrating vessel: whereby the use of valves, to admit the liquid into the measuring vessel and discharge it from the same, is rendered unnecessary.—[*Inrolled July*, 1851.]

To JOSHUA HORTON, *of Ætna Works, Smethwick, in the county of Stafford, steam-engine, boiler, and gas-holder manufacturer, trading under the style or firm of "Joshua and William Horton," for improvements in the construction of gas-holders.*—[Sealed 2nd January, 1851.]

THIS invention relates, firstly, to a novel construction and arrangement of guides of telescopic gas-holders, whereby the moveable parts of such gas-holders may be guided in a vertical direction as the volume of gas in the gas-holders increases or diminishes and it becomes necessary to increase or diminish the capacity of the gas-holder. According to the plans now in use for effecting this object, it is found necessary to erect, at a great expense, a guide-framing, having a greater elevation than the topmost part of the side of the inner gas-holder, when raised to its highest working point; but, by reason of the present invention, the columns and guides do not require to be more than about half the height of those usually employed. In carrying out this improvement, a series of vertical guides, attached to posts or columns, are set round the tank of the gas-holder in the ordinary manner, except that the columns are not required to be so high as usual. These posts or columns may be braced together at the top with circumferential tie-rods; and antifriction rollers are adapted to the gas-holder and its attachments, so as to work against the vertical guides attached to the posts or columns which are set round the tank; while other antifriction rollers are made to work against bars, plates, or rails, adapted to other parts of the gas-holder, or of the tank, so as to keep the parts separate and in a vertical position, and ensure the proper working of the apparatus.

The second improvement consists in adapting to the outer or inner sides of gas-holders vertical fixed bars or rails, which will present an even surface, suitable for receiving the pressure of the antifriction guide-rollers of the respective parts of the gas-holder: whereby the inconvenience arising from the use of loose bars will be prevented.

The third improvement consists in forming the top and bottom of the water-cup or hydraulic joint of gas-holders of sheet or plate-iron, wrought to the shape required for such parts, instead of using angle-iron and sheet-iron, bolted or rivetted together, which renders the manufacture more costly.

In Plate IV., fig. 15, represents a transverse vertical section, and fig. 16, a plan view of the inner and outer gas-holder. Fig. 17, is a transverse vertical section of parts of a gas-holder, constructed according to the invention, and drawn on a smaller scale than the preceding figures, in order that the mode of adapting and combining the inventor's several improvements may be better understood. One of the vertical columns, of which there are of course several, is shewn at A, A;—to this column the guide-rod or bar *a*, is attached. On the hydraulic cup, at the top of the lower part B, of the gas-holder, is fixed a guide-standard C, to which are attached antifriction rollers *c*, and *d*, *d*,—the former being intended to run against the vertical guides *a*, of the column A, and the latter against the guide-plate *b*, on the outer side of the upper gas-holder D. Outside the hydraulic cup of the inner gas-holder there is another antifriction pulley or roller *f*, which runs against a plate, bar, or rail *g*, secured to the side of the lower part B, of the gas-holder. It should be understood, that there are several of the standards C, fixed round the gas-holder on the hydraulic cup; and these standards are connected together by tie-rods *y*. Fig. 18, is a back view of the guide-standard C, shewing the antifriction rollers *d*, *d*, which run against the vertical rail or plate *b*, *b*, affixed to the outer side of the upper part D, of the gas-holder. A strip of wood *z*, *z*, is inserted in the groove of the standard or guide C, for the purpose of strengthening the same and rendering it stiff and rigid. Fig. 19, represents, on an enlarged scale, a sectional plan of these parts, and the manner of securing the vertical rail or plate *b*, *b*, to the upper part of the gas-holder. The arrangement and operation of the antifriction rollers *c*, and *d*, are also more clearly shewn in this than in the other figures. The plate *b*, *b*, consists merely of a flat piece of metal, of suitable strength, and secured in a vertical position on the sides of the gas-holder by means of rivets, or in any other convenient manner: this plate, it will be seen, forms part of the side of the gas-holder, instead of being a separate loose piece, adapted to the side by bolts, or otherwise, as is usually the case. The plate *b*, is strengthened at the back by a T-shaped piece *h*, which is rivetted thereto; and the antifriction rollers *d*, *d*, are kept in their place on the outer surface of the plate *b*, by angle-pieces *i*, *i*. Similar plates, bars, or rails *g*, *g*, are adapted to other parts of the gas-holder where required, as shewn in figs. 15, and 16. It will be found, that some of the principal advantages of making this plate *b*, part of the gas-holder, as above described, are,—first, that an even surface is obtained for the rollers *d*, *d*, or *f*, to run upon, thereby avoiding great friction; and, second, that there is less liability of corrosion than if loose bars were adapted to the sides of the gas-holder, inasmuch as there will be no difficulty in painting or protecting the surface. It will be seen, that the section of the guide *a*, of the column A, is in the form of a T; and, in order to prevent the antifriction roller *c*, from running off the guide, the roller is furnished with a flange. An antifriction roller or rollers may, if required, be mounted horizontally as well as vertically, for the purpose of keeping the gas-holder away from the sides of the tank.

The peculiar mode of constructing the hydraulic cup, which forms the third part of the invention, is shewn at figs. 15, and 16. Instead of forming the cup or valve of sheet or plate-iron, with angle-iron at the corners, as is the ordinary mode, a cup *k*, *k*, is made of wrought-iron, and secured at one side to the gas-holder, and at the other to a strip *l*, of sheet or plate-iron, by means of rivets, in order to form the other side of the cup or valve. By this means, as only one row of rivets on each side of the cup is required, a great economy in the construction of gas-holders is effected.

The patentee claims, First,—the use and application of vertical travelling guide-standards, fixed to the lower or outer gas-holder;—to which guide-standards, antifriction rollers are adapted, so that they may work against other vertical guides or plates as the parts of the gas-holder rise and fall with the increase or diminution of the quantity of gas contained therein. Secondly,—the use and application of the fixed guide-roller bars, plates, or rails *b*, *b*, (instead of loose bars, as is usual),—such fixed guide-bars, plates, or rails, being rivetted to, and forming part of, the gas-holder, and against which the antifriction rollers *d*, *d*, or *f*, work, as shewn and described. Thirdly,—the mode, herein shewn and described, of constructing the hydraulic cups or joints of gas-holders, or any other mere modification thereof, in which the top or bottom of the hydraulic joint or valve is formed of plates of iron, made or bent into a cup-shape, so as to admit of the valve being made complete, and attached to the gas-holder without the necessity of employing angle-iron and double sets of rivets, as is usually the case.—[*Inrolled July*, 1851.]

To Alfred Vincent Newton, *of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, mechanical draughtsman, for an invention of improvements in the construction of metal shutters,—being a communication.*—[Sealed 27th December, 1850.]

This invention relates to the formation of the joints of window and other shutters, made of plates or strips of iron, whereby a light economical shutter, capable of being rolled up around a cylinder, and being stiff and durable, may be produced.

In Plate IV., fig. 20, represents, in perspective view, the improved metal shutter, as applied to a window-frame; fig. 21, is an enlarged view of two plates or strips of iron,—shewing their mode of connection with each other; and fig. 22, is an end view, shewing the shutter wound around the roller. The roller, with the counter-balance weight and the endless chain for moving the shutter, are represented in the perspective view.

The construction of the shutter is as follows:—Strips of thin metal, of suitable width and breadth for the intended shutter, have their connecting ends bent round in opposite directions, as shewn at fig. 21, where two plates are represented in section. The curve *a*, it will be seen, is carried round further than that lettered *b*, and encloses an iron rod or wire *c*, which fills up the centre of the joint, and removes the liability of its being injured by indentation. The portion *b*, is formed to lock into the curve *a*, as shewn by the same figure; and, in order to unite them, the part *b*, must be slidden lengthwise into the part *a*; when they will form a joint that permits of the shutter being wound upon a cylinder. To prevent them from sliding out of place and binding, the ends of the wire are projected through the ends of the joints, and turned down after the strips or plates are united, whereby they are held securely in their place; and to cover the bent ends of the wire. and add to the strength of the joint by preventing any lateral motion of the plates on each other, and also to make an even edge to the shutter, so that it shall slide smoothly in the window-frame, the plates are each provided with two projecting pieces of metal or ears *d*, which are bent down, at right angles, over the joint, and thereby keep the plates in their place and make a neat finish. The vertical edges of the shutter run in grooves *e*, in the window-frame. It will be perceived that, in addition to the end pieces *d*, giving firmness to the shutter, they will prevent the several plates from catching as they pass from the cylinder or roller on which they are wound into the grooves of the window-frame. The shutter is attached—in the usual way of metal shutters—to the roller *f*, which is hung at the top of the window-frame in suitable bearings, and is provided with two pulleys *g*, and *h*, one on each end thereof. To the pulley *g*, a weight *i*, is attached, by means of a cord *k*; which weight acts as a counter-balance to the shutter; and around the other pulley *h*, an endless chain or cord *l*, passes down to a pulley *m*, in the inside of the window-frame; the axis of which pulley passes through and has a crank *n*, affixed to it for raising and lowering the shutter. For greater security, the ends of the plates, forming the vertical edges of the shutter, may be bent at right angles, and made to fit into L-shaped grooves, and thus prevent forcible ingress by springing the shutters out of place. This mode may be applied, with advantage, to the lower windows of buildings.

The patentee claims the constructing of metal shutters by connecting together the plates or strips of metal by joints, formed as above described.—[*Inrolled June*, 1851.]

To DAVID FARRER BOWER, *of Hunslet, in the parish of Leeds, in the county of York, manufacturing chemist, for certain improvements in preparing, rating (otherwise called rotting), and fermenting flax, line, grasses, and other fibrous vegetable substances.*—[Sealed 24th March, 1851.]

THIS invention relates to certain means, whereby the time required for effecting the rating operation will be considerably reduced, and the fibre of the rough plant will be less subject to deterioration than when submitted to the ordinary process.

It is well known that, after flax has been pulled and dried in the field, and the seeds removed therefrom, it is usually steeped, for some weeks, in water, in order to dissolve the glutinous matters contained in the plant. The stalks, after being allowed to remain some weeks in the water, are removed therefrom, and, when dried, are subjected to the scutching operation, to remove the woody matters from the useful fibre. The patentee has, however, found that the glutinous matter, although partially dissolved by the water, is not removed from the flax; but, when dried, a portion of the glutinous matter still adheres to the fibre, and renders it unfit for the scutching operation. According to this part of the invention, which has reference to the rating process now in common use, the flax or other fibrous substance is steeped in the ordinary way, either in cold or warm water:—if cold water is used, the flax must remain immersed for six days; but a much shorter time will answer if warm water is employed. The flax is then removed from the water and passed between pressing-rollers, for the purpose of expressing the glutinous matters from the interior of the plant. After this, it is again steeped in cold or warm water for a similar period, and a second time submitted to the squeezing operation. The flax is then dried and treated in the ordinary manner; and it will be found to be much clearer of the glutinous matter than if merely steeped for a much longer time, and operated upon in the ordinary way.

For the finer descriptions of flax, and when a good colored fibre is required, the plant is steeped in a solution of caustic ammonia, or the neutral salt of one of the alkalies. The salts preferred to be employed are chloride of sodium (common salt) or sulphate of soda. The quantity of the alkali or salt required to be dissolved in a given portion of water will depend upon the temperature at which the process is to be carried on, and the quality of the water employed: in other words, the quantity of alkali or salt required will depend upon whether the impurities contained in the water consist of the salts of iron, or of lime or other matters. When common rain-water is employed, one pound of caustic ammonia, or one pound of any of the neutral salts, is added to every 150 gallons of water; and, with this solution, the process may be carried on, at any temperature from 90° to 120° of Fahrenheit's thermometer, and the operation will be completed in about 30 hours. If, however, cold water is employed, the quantity of the alkali or salt must be somewhat increased, and the operation will be completed in about four days. The mere admixture of the above-named chemical ingredients with the water, in which the plant is steeped, will very much facilitate the rating process; but if, in addition, the fibres, after being submitted to the action of the alkaline solution for a time, are passed between rollers or are otherwise subjected to pressure, to express or squeeze out the dissolved glutinous matters, the process will be still further facilitated, and otherwise greatly improved.

Another improvement in the preparation of this kind of vegetable fibre consists in operating upon the plants or stalks in an exhausted vessel. In carrying out this part of the invention the flax or other fibrous substance is pulled and dried in the field, and the seed removed in the ordinary manner. The flax is then placed in a cylindrical or other shaped air-tight vessel, and the air is exhausted therefrom by means of an air-pump; after which a solution of one of the following materials is let into the exhausted vessel: viz., caustic ammonia, chloride of sodium, sulphate of soda, or any neutral salt of any of the alkalies of ammonia, soda, or potash. These materials are added in or about the proportion of one pound of ammonia or one pound of one of the neutral salts to 150 gallons of water, which should be kept at a temperature of from 90° to 120° Fahr. It is evident that, by exhausting the vessel and drawing out the air contained in the cellular tissues of the plants, the latter will be brought into a condition to be more easily and rapidly acted on by the chemical agents employed. The alkaline solution being now let into the exhausted vessel, the flax will readily absorb it. In this saturated state it should be allowed to remain for from two to four hours; after which the liquor should be run off from the vessel, and the air again exhausted therefrom: this will have the effect of extracting the dissolved glutinous matters from the interior of the plant. After this second exhaustion, the fibrous materials are removed from the vessel and laid up in a heap, so that they may cool down gradually; after which they should be spread out in a field or drying shed; and when dry they will be ready for the scutching operation. Instead of using an alkaline solution, hot water may be let into the air-tight vessel, after the air has been exhausted therefrom, to effect the same object.

Instead of subjecting to mechanical pressure flax, or other similar plants that have been steeped in open vessels, as described under the first part of the invention, the patentee sometimes subjects the plant, after it has been steeped long enough, to the exhausting operation, for the purpose of extracting the glutinous matters from the interior of the fibre, and removing the superfluous moisture therefrom.

The patentee claims, First,—subjecting flax, line, grasses, and other fibrous vegetable substances, which have been steeped in water or other liquid, to mechanical pressure, for the purpose of expressing or squeezing out the dissolved glutinous and other matters contained in the plant. Secondly,—steeping flax, line, grasses, or other analogous vegetable fibrous substances, in a solution of ammonia, of chloride of sodium, of sulphate of soda, or of any other neutral salt of the alkalies ammonia, soda, or potash. Thirdly,—the employment in the preparing of flax, line, grasses, and other fibrous vegetable substances, of the process of exhaustion, as before described, to accelerate the detaching from the fibre the glutinous and other matters contained therein.—[*Inrolled September,* 1851.]

To HENRY WALKER WOOD, *of Briton Ferry, near Neath, Glamorganshire, Gent., for improvements in the manufacture of fuel.*—[Sealed 7th December, 1850.]

THIS invention relates to the manufacture of fuel by mixing coal or coke with some other substance or substances, such as pitch, coal-tar, resin, or other pitchy, fatty, or resinous substances. The improvements consist, when coal is used, in heating it before adding the other substance or substances thereto; and, when coke is employed, in adding the other substance or substances to it while it yet remains in a hot state after being taken from the coke oven.

The following is the mode of making fuel with coal according to this invention:—The coal, in small pieces, is made hot, and put into a mixing machine, which has a shaft with projecting arms, similar to the common pug-mill employed for working clay; then an addition is made thereto of a suitable quantity of pitchy, fatty, or resinous matter, and the shaft is caused to revolve; and when the whole is thoroughly mixed, it is pressed into blocks of the desired size. Fuel is prepared in the same manner with coke, except that it is used hot as it comes from the coke ovens,—being first passed between rollers, if not sufficiently small.

The patentee claims, as his invention, the making of fuel with coal or coke, in combination with some pitchy, fatty, or resinous substance or substances necessary for making a good and serviceable fuel, by applying heat to such coal or coke previously to the admixture or combination thereof with such other substance or substances. He also claims the exclusive use of this preparation or any other preparation of a similar character for the purpose of preventing the decomposition of coal, and of preserving coal by enclosing it in a covering of this mixture, or by covering it with any other material better suited for the purpose.—[*Inrolled June*, 1851.]

To WILLIAM STONES, *of Queenhithe, in the City of London, stationer, for improvements in the manufacture of safety paper for bankers' cheques, bills of exchange, and other like purposes.*—[Sealed 24th February, 1851.]

THE object of this invention is to manufacture a paper that will indicate, by discoloration of its surface, when an attempt has been made to extract written characters therefrom, and thereby to afford to bankers, merchants, and others, protection against forgery, or the tampering with cheques, bills of exchange, and other important documents.

The invention consists in the employment of iodine or bromine, together with ferrocyanide or ferricyanide of potassium and starch, either in the manufacture or preparation of safety-paper. For this purpose, iodine or bromine is used, in any of their ordinary combinations, with bases; but iodine being the cheaper material is preferred to any compound of bromine. Of the compounds of iodine, the patentee employs, in preference, that known as iodide of potassium,—such substance being the most readily attainable in the market, and in no degree affecting the color of the paper. The mode of applying this substance is by mixing it with the pulp or size; or the paper may be saturated with a solution of the metallic iodide. The ferrocyanide or ferricyanide of potassium is mixed with the size; or it may be applied subsequently to the sizing, as in the case of the metallic iodide. The starch is preferred to be mixed with the pulp in the engine; but it may, like the other chemical ingredients, be used in an after stage of the process.

The proportions for these several materials, used for rendering paper sensitive to the action of re-agents, are by no means absolute; but, as a guide, it may be stated, that the following have been found to answer the purpose, viz., for a ream of post, weighing about 18 lbs.,—

1 oz. iodide (or bromide) of potassium,
¼ oz. ferrocyanide (or ferricyanide) of potassium,
1 lb. starch.

On the application to paper, prepared as above set forth, of re-agents, to dissolve out or absorb any ink-markings therefrom, the tendency will be to break up one of the salts named: thus, on the application of chlorine or mineral acids, the iodine will be liberated, and, combining with the starch, will form an insoluble iodide of starch of a dark color; and, further, the iron, which ink generally contains, being attempted to be dissolved by either vegetable or mineral acids, the ferrocyanide of potassium will combine with it in solution, and form the well-known Prussian blue compound, which will become diffused over the adjacent portion of the paper.

The patentee claims the application and use of iodine (or bromine), in its combined state, with a base of ferrocyanide (or ferricyanide) of potassium and of starch, for the purpose above set forth.—[*Inrolled August,* 1851.]

To WILLIAM TUDOR MABLEY, *of Manchester, in the county of Lancaster, patent agent, for an invention of certain improvements in the manufacture of soap,—being a communication.*—[Sealed 3rd October, 1850.]

THIS invention relates to the production of rosin-soap from crude turpentine,—such soap being suitable for use in combination with tallow, or other grease-soap, or not, as may be desired.

The method of carrying the invention into effect, and the proportions of ingredients, may be varied to a considerable extent; but the following, however, is the course which the inventor usually follows, in order to effect the required object:—One thousand parts of crude turpentine are to be melted by means of steam, or other suitable application of heat, and four hundred parts of soda-ley, containing thirty-three per cent. of pure dry soda added thereto: the vegetable acids constituting the rosin of the turpentine are thus neutralized, and soap is formed in a liquid or melted state; and, at the same time, the essential oil of the turpentine is set free. In order to extricate this essential oil from the mass, a solution of common salt is to be added, the vessel containing the compound is to be connected with a condensing apparatus, such as is usually employed by distillers of spirits of turpentine, and heat is to be applied to the saponaceous mixture by means of coiled steam-pipes, or otherwise, so as to raise the compound to the boiling point. The steam that rises from the compound carries with it the essential oil of turpentine, and becomes condensed in the condensing apparatus; and, in the vessel first employed, will be left the rosin, perfectly saponified (being, in fact, rosin-soap) and floating on the solution of salt.

A solution of common salt is used in preference to water only, inasmuch as it will better buoy up the soap by reason of its greater specific gravity, as well as produce steam for the distilling process; but other fluids may be used instead of a solution of salt. Instead of using the ley so highly concentrated that it contains thirty-three per cent. of dry soda, it may be used in a less concentrated state, for distilling the essential oil from the crude turpentine; and in this case the solution of salt may be dispensed with in the process of distilling. A favorable result may be obtained by using a ley of 20° Beaumé, after the following manner:—With the melted turpentine one half of all the ley required for saponifying the whole is to be mixed; and then, the distillation being commenced, the remainder is to be added gradually through a suitably-arranged pipe, in the same ratio as the water and spirits distil over. Even a concentrated solution of soda-ash in water will answer for distilling the turpentine in the same manner; but in such case great care must be taken on account of the carbonic acid gas being discharged from the mass: for every four pounds of crude turpentine one pound of soda-ash, containing fifty per cent. of pure dry soda, is sufficent for saponifying the same,—whether the soda be used in the caustic or carbonated state.

The soap remaining after the distilling operation may be washed in a concentrated solution of common salt, in order to free it from the coloring matter produced by the action of the alkali on the rosin. The distillation itself may be carried on in a copper still, such as is used by distillers of spirits of turpentine, or in a wooden vat, connected with a suitable condensing apparatus,—the saponified mixture being heated by steam, or other means: if the former, it may be used in close pipes, or in such as are perforated, so as to admit the steam into the mass. The soap, produced by this improved method, will, by itself, answer all ordinary purposes of washing; but it may be combined with tallow or grease-soap in any desired proportion. A good firm article, of light color, may be made by combining one hundred parts of a well-made grease-soap with two hundred parts of the rosin-soap. The spirit of turpentine, obtained by the distillation of the crude turpentine, which has been neutralized with an alkali, differs somewhat from that obtained in the ordinary way,—being free from rosin, it is more easily soluble in absolute alcohol, and burns with a brilliant light, leaving no residuum. Although certain proportions of the ingredients have been mentioned, and particular apparatus referred to, yet the same may be varied to a considerable extent, without departing from the principle of the invention.

The claims made by the patentee are, Firstly,—the making of rosin-soap from crude turpentine, without the use of tallow, fat, or other grease. Secondly,—the distillation of the essential oil of turpentine, substantially as above described, to form soap.—[*Inrolled April,* 1851.]

To John Swindells, *of the firm of Swindells and Williams, of Manchester, and Ince, near Wigan, manufacturing chemist, for certain improvements in obtaining products from ores and other matters containing metals; and in the preparation and application of several such products for the purpose of bleaching, printing, dyeing, and color-making.*—[Sealed 14th November, 1850.]

This invention consists, first, in certain methods of obtaining metals and other porducts from ores containing copper and silver, or copper only, from ores containing zinc, and from ores containing chromium; and secondly, in applying part of these products to the purposes of printing, dyeing, and producing color, and also bleaching or discharging color.

The following is the method of treating ores containing copper and silver, or copper only:—After the whole or nearly the whole of the sulphur has been extracted by roasting or other suitable means (reducing the ores to oxides), the prepared ore is put into water-tight tanks, and a weak solution of ammonia is pumped thereon, until the ore is completely saturated: the strength of the solution is preferred to be about 0.980. The solution is allowed to remain on the ore for a period varying from twelve to twenty-four hours, according to circumstances; and when it is drawn off, the ammonia will be found to be saturated with oxide of copper, and, if silver be present, with oxide of silver also. The silver and copper may then be separated by any of the usual methods; but it is preferred to precipitate the silver by hydrochloric acid, or salts containing it, and afterwards to separate the copper by hydrosulphuric acid, or salts containing that acid.

To extract zinc from the native sulphuret of that metal, the ore is mixed with about its own weight of common salt, or muriate of potash, or the muriate of any of the earths (common salt, however, being preferred), and calcined in an oxidizing flame, by a slow protracted heat, until the sulphur is converted into sulphuric acid. Then the products of the operation are separated by dissolving in water the soluble products, which will consist of sulphate of soda, muriate of zinc, and muriate of iron; these are separated by first obtaining the sulphate of soda, and then precipitating the oxides of zinc and iron by lime, or any other alkaline earth or substance; and the oxide of zinc is afterwards smelted in the ordinary manner.

Ores containing chromium are treated in the following way:—The ore is first pulverized, and mixed with its own weight of common salt, or muriate of potash, or hydrate of lime. Then, if it is desired to obtain a product containing soda as the alkali, the mixture of ore and common salt is subjected, in a reverberatory furnace, to a full red heat, or even to a white heat; at the same time a jet of steam at a very elevated temperature is applied; and the mixture is stirred every ten or fifteen minutes, until the required effect is produced: which will be ascertained by taking a small quantity of the mixture from the furnace and testing it. When the process is finished, the product will be chromate of soda,—the hydrochloric acid having carried away the whole or nearly the whole of the iron in the shape of sesquichloride of iron; and the product withdrawn from the furnace is treated as usual in the manufacture of chromic or bichromic salts. The mixtures of ore with muriate of potash and of ore with hydrate of lime are also treated in the manner just described. From the mixture of ore and common salt, pure bichromate of soda is manufactured, and, by the addition of hydrochloric acid, chlorochromate of soda is produced. From the lime mixture, chromate of lime is manufactured, or, by the addition of soda or potash, a compound salt of soda or potash and lime.

The patentee claims, first,—the extraction of copper and silver from their ores by the use of a solution of ammonia or salts containing ammonia. Secondly,—the improved method of extracting zinc from the native sulphuret of zinc by the process of roasting the ores with common salt, or any other article or substance containing muriatic acid. Thirdly,—the process of forming chromic salts by operating on the ores mixed with muriatic salts subjected to the action of steam. Fourthly,—the use or application of pure bichromate of soda (instead of the bichromate of potash hitherto in use) for the purpose of producing color, or raising vegetable or metallic colors, or discharging colors, when so applied for that purpose. Fifthly,—the use or application of chlorochromate of soda, potash, or lime (as new compounds not before used) in producing color, and also in bleaching or discharging color. Sixthly,—the compound salt of chromate of soda and lime, or chromate of potash and lime, for the uses aforesaid,—being a more economical and useful salt for producing orange colors than those heretofore in use.—[*Inrolled May,* 1851.]

To WILLIAM ONIONS, *of Southwark, in the county of Surrey, engineer, for certain improvements in the manufacture of steel.*—[Sealed 7th February, 1851.]

THIS invention consists in a mode of manufacturing cast-steel by melting certain matters together and annealing the product.

The patentee takes two parts, by weight, of hæmatite ore (that is, iron ore of the character known as Cumberland ore), reduced to a state of coarse powder by grinding or beating, and puts the same into a crucible; he then adds thereto four parts, by weight, of steel, made in the ordinary way, and ninety-four parts of iron, broken into small pieces,—the iron used being that made from Cumberland ore, or other iron which can be rendered malleable by annealing; and he melts these materials together. Instead of first running the metal into ingots or bars, and then re-melting it, he casts it at once, in sand-moulds, into the articles required to be formed of cast-steel. These castings are rendered malleable by the process of annealing, and may be tempered in the same way as articles made of ordinary steel. The annealing process employed is that by which castings of iron, made from Cumberland and like ores, are rendered malleable. The articles are put into pots or boxes with pulverized Cumberland ore, or other matter usually employed, and subjected to heat, in an annealing oven, for a time dependent upon the thickness or substance of the articles under treatment. The articles which are annealed at the same time should, therefore, be as nearly as possible of the same thickness; and the heat should not be permitted to increase rapidly, nor to attain too high a temperature. The time required for the annealing process will be ascertained by practice. To anneal articles about an inch square (supposing the metal to be in bars of that thickness), they should be kept at a red heat for 120 hours; the time occupied in raising them to that heat should be 24 hours; and, after they have been kept at a red heat for 120 hours, they should be allowed to cool down very gradually,—say in not less than 24 hours. The articles, thus annealed, may be turned or otherwise reduced to the desired shape by the ordinary tools, and may be tempered in the same manner as articles made of common cast-steel.

The patentee does not confine himself to the above details; but he claims the mode of manufacturing cast-steel by melting matters together and annealing the products, as above described.—[*Inrolled August,* 1851.]

INSTITUTION OF MECHANICAL ENGINEERS, BIRMINGHAM.

The following paper, by Mr. Paul R. Hodge, of London, was read.

On the progress of improvements in locks in the United States of America.

The present communication is intended to shew the insecurity of English locks generally, and to bring under the notice of the Institution the ingenious lock of Mr. Newell, of New York.

It was conceded, about twelve years since, in the United States, by all locksmiths, that a lock having a series of tumblers or slides, such as was used at that time in Europe, and more particularly those of Barron and Chubb, was secure against all known means of picking, or of forming a false key by any knowledge that could be obtained through the key-hole. The only point that seemed desirable was, to make it secure against the maker, or any party who might have had possession of the key, and from it taken an impression. The first step, therefore, was to construct the lock so that the party using it could change its form at pleasure.

The most successful locksmith, for a time, was a Mr. Andrews, of Perth Amboy, in the State of New York. He constructed a lock similar to that made by Mr. Chubb, having a series of tumblers and a detector; but, before placing the lock on the door, the purchaser could arrange the tumblers in any way, so that the combination suited his convenience; and the key, being made with a series of moveable bits, was arranged in a corresponding combination with the tumblers.

In order to make a change in the lock without taking it from the door, each tumbler was so constructed that in locking the lock the tumbler could be raised, or drawn out with the bolt. A series of rings was furnished with the key, corresponding with the thickness of the moveable bits of the key; and any one, or as many more of the bits, could be removed from the key, and rings substituted. These bits being removed, and the rings taking their place, the corresponding tumblers would not be raised by the turning of the key, and consequently would be drawn out with the bolt (becoming, in fact, a portion of the bolt itself). Therefore, when a bit was removed and a ring substituted, so much of the security of the lock was lost as depended on the tumbler that was not raised: consequently, a lock having twelve tumblers, on being locked with a key with alternate bits and rings, would evidently become a six tumbler lock; but should a tumbler that was drawn out with the bolt be raised in the attempt to pick or unlock it, or should any one of the acting tumblers be raised too high, the detector would be thrown, and prevent the withdrawing or unlocking of the bolt. This lock was in great repute in the United States, and was placed on the doors of nearly all the principal banking establishments of the country: a large reward was offered by its maker to any one who could pick it; and from its great repute it consequently called out many rivals.

Mr. Newell, of the firm of Newell and Day, of Broadway, New York, was the most successful competitor, by constructing what he termed his permutating lock, which was composed of a series of first and secondary tumblers,—the secondary series being operated upon by the first series.

Through the secondary series there was passed a screw, termed a clamp screw, having a clamp overlapping the tumblers on the inside of the lock;—each tumbler in the series having an elongated slot to allow the screw to pass through. On the back side of the lock was a small round key-hole, in which the head of the screw rested, forming as it were a receptacle for a small secondary key; so that when the large key gave the necessary form to the tumblers, the party took the small key and operated on the clamp screw, clamping and holding together the secondary series, and retaining them in the relative heights or distances imparted to them by the large key. The door was then closed, and the bolt projected; and the first series of tumblers fell again to their original position.

The objection to this mode of constructing a lock was, that it required the insertion of the small secondary key; and should the party neglect to release the clamp screw every time he unlocked the lock, the first series of tumblers would be held up by the secondary series. Consequently, an exact impression of the lengths of the several bits of the key could be obtained through the keyhole while the lock was unlocked.

Another and a more convenient method was devised by Mr. Newell. On each of the secondary tumblers he made a series of notches, corresponding in distance with the difference in the lengths of the several bits of the key;—on turning the key each bit raises its plate or tumbler, so that some one of the notches presents itself in front of a tooth on a lever pendent from the bolt. When the bolt is projected, the secondary series are held in their position by the tooth of this lever, whereby the necessity for the secondary key is avoided. In unlocking the lock, the tumblers are released from the tooth and fall to their original position, and the lock again becomes a blank.

It will be seen that there was no improvement in the actual safety of the lock against picking,—the only object being to make a lock that could be changed by the party using it in the most effectual manner.

These improvements were all made prior to the year 1841; so that ten years ago many very valuable additions had been made to the detector and tumbler lock.

In the course of Mr. Newell's studies, he conceived that the lock of his competitor, Mr. Andrews, might be picked; and the result was the picking of it by a very simple instrument, which was exhibited to the meeting.

Mr. Newell immediately afterwards picked his own with an instrument of a similar construction; so that, in investigating the principle by which he could pick the lock of his rival, he discovered also means by which he picked his own; and his candour in this affair was certainly greatly to his credit, in making it known at once, and not concealing that his lock, as well as all others based on the tumbler principle, was insecure.

The question then was, with him and other makers of locks, in what way should they make a secure lock? The first step taken was to add a series of complicated wards to the lock; but it will be readily seen that what can be reached with a key could be reached by some other instrument; and although it required an instrument of a different form, yet the operation was just as certain and fatal to the security of the lock.

The next step taken, and one which was considered effectual, for a time, was the notching of the abutting parts of the first and secondary series of tumblers, or of the stump face and the ends of the tumblers. So that if a pressure was put upon the bolt, the tumblers could not be succesively raised by the picking instrument, being held fast by these "false notches." This lock baffled the skill of all the country for a time, and was considered perfectly safe, until an ingenious engineer, of the name of Pettis, informed Messrs. Newell and Day that he believed it was possible to pick their lock. They immediately put him to the test, and had the satisfaction of losing 100 guineas, which they promised him if successful, as well as their reputation as locksmiths.

The lock in question is now in the United States department of the Great Exhibition, and can be examined by any person; its workmanship is beautiful, and it contains all the points of security hitherto known and used in tumbler locks; it has sixteen tumblers, a detector, and false notches; yet Mr. Pettis overcame all these obstructions, and picked it fairly. What was then to be done? The alarm can be readily conceived of every banker, merchant, or broker, who supposed that they had a sure protection in that lock. The conclusion arrived at by Mr. Newell was, that security could only be obtained by constructing a lock so that the obstructions to the withdrawing of the bolt could not be ascertained through the key-hole.

Upon this principle, and with this object in view, the Parautoptic lock was invented by Mr. Newell, retaining all that was deemed good in the locks previously made, and at the same time guarding against all the defects proved by actual experiment. A specimen of this lock was exhibited to the meeting.

There are several features in the construction of this lock deserving of particular attention. The most novel feature is, that the lock changes itself to the key;—in whatever form the moveable bits on the key are changed, the lock answers to that form, without moving any part of it from the door.

The party purchasing the lock can change it to suit his convenience. If a 6-tumbler lock, 720 times; if 7 tumblers, 5,040; if 8, 40,320; if 9, 362,880; if 10, 3,628,800, and if 12, 479,001,600. Therefore, it will be perceived that, by changing the numerical position of the bits in the key, the lock can be altered, or in fact alters itself, to any number of new locks, equal to the permutation of the number of bits on the key. Two extra bits are supplied with each key, which add very greatly to the number of changes. As the key turns round, each bit raises its tumbler to a point corresponding with its length, imparting to the first and secondary series the exact form of the key. The secondary series of tumblers being carried out with the bolt, and the tooth on the lever or dog being pressed into the several notches on the front face of the secondary series, holds them in the position given them by the key, while all the other portions of the lock fall again to their original position.

Should a pressure be put on the bolt to ascertain the obstruction, it will be readily seen that it will be brought to bear on the third or intermediate tumblers. To prevent the possibility of reaching these, there is a wall of metal fixed across the lock, which confines the operator wholly to the key-chamber. By detaching the portion of the tumbler that takes the pressure given to the bolt from the parts that can be reached through the key-hole, leaving that portion always at liberty, the possibility of ascertaining what is wrong is cut off; so that instead, as in the former lock, of having only a first and secondary series, Mr. Newell here introduced a third or intermediate series; thereby throwing the whole security of the lock into a chamber beyond the wall of metal, which is wholly inaccessible, and forming as it were another lock without a key-hole. These are the principle features of security in Mr. Newell's Parautoptic lock.

There is another source of insecurity that has still to be provided against. When the first tumblers can be seen through the key-hole, if the under side of them is smoked, by introducing any flame, the key will leave a distinct mark upon each tumbler the next time it is used, shewing where it began to touch each tumbler in lifting it. This can be seen by inserting a small hinged mirror into the lock through the key-hole, and the exact length of each bit of the key measured, from the centre-pin to the point where it touched the particular tumbler, from which a correct copy of the key can be made. (An electric light from a small portable battery has been employed for this purpose, to illumine the interior of the lock.)

The possibility of seeing the tumblers is entirely prevented by surrounding the inside of the key-hole with the ring or revolving curtain; and when this curtain is turned, to bring the opening opposite the tumblers, the key-hole is shut on the outside by the detector tumbler, which tumbler would also detect all attempts at mutilating the interior parts of the lock.

Should the lock be charged with gunpowder, through the key-hole, for the purpose of blowing it from the door, the plug in the back of the key-chamber yields to the force, leaving the lock uninjured; whilst the curtain protects the interior of the lock from injury; thereby effectually preventing all known means of opening or forcing the lock.

Mr. Chubb said he considered that he had been treated with unfairness in the trial that had been made of his lock, and complained of the manner in which the lock that had been picked was procured from him.

The Chairman remarked, that the object of the discussion was to ascertain the relative merits of the American lock described in the paper that was before the meeting, and the discussion should be confined to the mechanical part of the question.

Mr. Chubb wished to explain that the lock and keys which

Mr. Hobbs (Mr. Newell's agent) had picked, were purchased by Mr. Hobbs, and remained seven days in his possession before the trial took place; and any lock might, in a few hours, be made safe to be picked. He wished to shew that it had not been done in a fair way. He had given in the *Times* newspaper a public challenge to Mr. Hobbs to come and pick one of his locks, which he had put upon a door for the purpose, but that had been declined. He denied emphatically that any one could pick, within any reasonable time, one of his locks which had not been tampered with.

Mr. Chubb then produced two locks, which he said were of his ordinary make, and offered that they should be examined by the Chairman and Mr. Scott Russell, to ascertain that there was no unfairness about them, and then put upon a door, and that Mr. Hobbs might come one day to take the impression of the key-hole, and then come five hours any day during the week, and pick the locks if he could.

Mr. Scott Russell said he thought that was the definite point to be arrived at. He had not been acquainted with the American lock before, and was much struck with its ingenuity and perfection. He certainly considered it to be unpickable, and had a fear that Mr. Chubb's lock was pickable, and he was glad to hear of the present offer. If Mr. Chubb liked to put those locks on the table, with the challenge to pick them, and they were not picked, it would be a practical illustration of the excellence of the locks. He suggested that it would be most eligible for the Council of the Institution to appoint a committee of two or three qualified persons to act as arbitrators in the trial.

The Chairman remarked that the object of the paper read at the meeting, was to ascertain the relative merits of the different kinds of locks; but it was not advisable that the Institution should do more in this matter than afford an opportunity for a fair and open discussion, and also for recording the facts of any experimental trial of the different locks. The discussion had now brought them to the point of Mr. Chubb bringing forward his lock, and offering to the American lock-maker an opportunity to try and pick it.

Mr. Scott Russell suggested that it would be most satisfactory for two or three mechanical men to be appointed a committee, to settle what should be the terms of the trial, which should be fair to both parties, as a test of the respective locks. That would be an *experimentum crucis*, to bring the question to a settlement.

Mr. Hobbs begged to explain that he had not come over to this country for the purpose of picking locks, but to dispose of his own lock. He was a lock manufacturer; and in the course of explaining the merits of his own lock, it was necessary to shew that the locks of other makers were insecure. He did not refer to Mr. Chubb's lock in particular, but to the general principles of tumbler locks in this country, which he maintained were insecure and could be picked; and in his own lock the insecurity that he alleged in other locks was guarded against. The challenge respecting his own lock was, that a party might take any commercial lock, examine it as much as he pleased, without limit of time, and take the lock to pieces and put it together again, in the presence of competent persons; the lock to be then locked in their presence, and if the party could pick it in any time and after any number of trials, a prize of £1,000 would be given. With regard to the mode of picking the regular tumbler locks, it was a plain mechanical operation with the instrument that had been described.

Mr. Chubb requested that the terms of his challenge might be taken down by the secretary, who replied that he had done so.

A member wished to ask whether Mr. Hobbs did not pick one of Mr. Chubb's locks, at the Exhibition, in seventeen minutes?

Mr. Hensman replied that Mr. Hobbs had done so, and the lock, he believed, was the same as the one laid before the meeting. He examined the lock, and believed it had not been tampered with in any way; he then locked it, and in seventeen minutes Mr. Hobbs picked it fairly in his presence, with the description of tool that had been shewn to the meeting. He thought that Mr. Chubb should examine the lock, to see that it had not been tampered with; he understood that the lock had been purchased by Mr. Hobbs for the purpose, at Mr. Chubb's shop.

Mr. Appold remarked that he was also present at the trial, and he confirmed Mr. Hensman's statement. The number of the lock was 142,352.

The Chairman said that the further consideration of the subject had better be left to a committee appointed by the parties themselves, independent of the Institution, to avoid involving the Institution in any contest of mechanical skill; the members of the Council would be glad to assist, and he hoped the facts of the experiments would be laid before a future meeting.

[Since the date of this discussion, Mr. Hobbs has given a further proof of his skill by picking a specimen lock of Messrs. Bramah, on the security of which that firm had staked 200 guineas.]

THE General Meeting of the Members was held at the House of the Institution, Newall-street, Birmingham, 30th July, 1851,—Mr. J. E. McCONNELL, Vice-President, in the Chair.

The following paper, by Mr. Henry H. Henson, of London, was then read:—

On improvements in the construction of railway waggons.

The object of this paper is to shew the progress of construction in railway waggons,—explaining the gradual changes enforced by circumstances and experience.

The original form of goods waggon generally employed on railways, from the opening of the Liverpool and Manchester line, in 1829, and for many years afterwards, was nothing more than a platform upon wheels, about 10 feet long, with sides varying from 4 to 10 inches in height above the floor. Indeed many of them are still employed, and for certain portions of the traffic, such as minerals, casks, stone blocks, iron pipes, and sundries, they are as well adapted, as they are unfit, unprofitable, and dangerous, if employed in the conveyance of merchandise generally. The load per waggon was about 2 tons;—the weight of the waggon from about 2½ to 3½ tons.

The unfitness of the low open waggon was very early perceived, and the improvement required faintly foreshadowed by the addition of portable sides and ends, which were merely open crib-rails, dropped in staples at the sides and ends of the waggon, and secured at the corners by hooks and eyes. To this slight improvement was soon added the worst evil of all,—the inflammable and expensive tarpauling: the use of which has involved such costly contingencies. The most striking defect, common to the open waggons, is the facility with which large bales fall from the trucks upon the line. In shunting and starting the train, it is clearly impossible that the goods can keep their position on the floor of the waggon without the protection of sides and ends. The crib-rails and tarpaulings are not only very costly, considering they fail to answer the purposes of safety and protection, but their use has entailed great danger and expense. Serious accidents have happened from the negligent way in which the portable sides and ends are suffered to lie about the railway; and the falling of the same from the waggons is an occurrence which has been attended with serious derangement of the traffic. Trouble and expense are also constantly recurring from the great labor of taking down and refixing the crib-rails to the waggons; and if it be said they are not always removed, then the trouble of loading and unloading must be greatly increased. Neither can the important item of repairs be said to be moderate, if considered, as it should be, in relation to imperfect service and maintenance of crib-rails and tarpaulings;—to which may be added claims for damage done to the goods carried by these trucks.

The improved open goods waggon, used upon railways at the present time, has fixed high sides, with doors at the end, and is covered with a tarpauling. The faults of the tarpauling are so well known to all connected with the practical use attempted to be made of it, that the writer will only observe, that its employment should only to a very limited extent have been permitted in the conduct of the railway traffic. In a conversation with one of the great carriers, he was informed that the yearly cost of tarpaulings to the firm was £3,000; and one item of this expenditure arose from the employment of eight men kept for the purpose of repairing the tarpaulings. The writer believes he is perfectly correct in stating, upon the same authority, the use of tarpaulings to have been a charge of 4d. per ton upon the goods. The tarpaulings were certainly extensively used in the inland navigation of the canals, to protect the contents of the boats from water; but the same means have been employed, with strange inconsistency, to protect the goods carried by railway from fire. The costliness of tarpaulings may be inferred from the fact, that to some large companies the annual expenditure for them is about £12,000, exclusive of all the other expensive contingencies inseparable from their use. In wet weather, the writer has seen as many as three tarpaulings used in covering the contents of a single waggon, and even these have failed to keep the merchandise dry. This arises from the great number of small holes which are daily made in them, from some sharp point or angle of a package cutting them through. So uncertain is the probable duration of a tarpauling, that a new one is sometimes spoiled the first day of its employment,—each tarpauling costing from £4 to £6.

It is evident that an open truck is a box without a lid, whether it be made with crib-rails or deal-board sides and ends. Over this a tarpauling is thrown by three or four men, who attempt to secure it, by pieces of rope provided for the purpose, to the hooks or rings attached to the waggon; but it often happens that the trucks are not filled to a level with the top side of the waggon: the consequence is, that when heavy rains fall, the weight of the water collected on the top of the tarpauling is so great, as to invert it in the centre, making a pond or dished cistern, of about nine inches deep, or more, containing many gallons of water. The Goods Manager of one of the great lines informed the writer, that in the wet season he has employed as many as twenty men to throw off the water collected on the tops of the tarpaulings, and tighten them on the road, at one station only; but that on their arrival at London they were again in the same state: this was when the tarpaulings were sound. In those cases where they were not water-tight, the damage done was serious: tea, sugar, cheese, silks, and indeed all other goods, were more or less damaged,—entailing complaints from the public, and much loss to the companies.

The extent of the improvements in the construction of railway waggons may be inferred from the fact that, ten years since, the stock on one great railway company was only one-fifth of its present number, and the money-receipts about one-sixth; yet the annual cost for maintenance is now not double the amount it was at the period referred to.

The attention of the writer was forcibly called to the immense loss occurring whenever an accident took place, not only from damage done to the goods in the open waggons broken up, but also much more from goods thrown out of the same when off the line;—the ordinary open waggon being no better than a box or basket without a cover, from which is ejected the whole of its contents when the waggon is turned over; and this has sometimes been upon the rails, into a field, a ditch, down an embankment, or into a canal. These evils were often the subject of remark; and finding that no one attempted to improve the system, the writer contrived the new covered goods waggon represented in Plate IV., at figs. 23 and 24;—fig. 23, being a side elevation, and fig. 24, a transverse section thereof on an enlarged scale. This subject is brought forward for the purpose of calling attention to the remarkable contrast which has been found by experience to result from the use of the new covered waggon, as compared with the open waggon. Accidents to trains containing the new covered waggons have happened: some of them have been thrown to the bottom of steep embankments, and others forty feet from the rails, into a field, and, in fact, exposed to all the violence of collisions taking place with trains consisting of seventy waggons, travelling from twenty to thirty miles an hour, and loaded on an average with 3½ tons each,—the gross weight in motion being about 490 tons. The contents of the covered waggons have been preserved, in most instances, from any damage whatever; while the waggons themselves, from the peculiarity of their construction, have sustained so little damage as to have excited particular notice. A case recently occurred of two of these being thrown off the rails, while the train was at full speed, containing 4½ tons of goods each, which were not at all damaged,—neither was the square of the waggons found to have been broken. In the year 1830, the speed of passenger trains was under twenty miles per hour; but at this period the speed of goods trains reaches from twenty to thirty miles an hour, with a degree of safety not at all second to the passenger trains: therefore, the sound construction formerly necessary for passenger carriages became fully needed by the present requirements of the traffic for the goods waggons.

An important feature in the new covered waggon is the perfectly even and smooth interior of the sides and ends of the body, or loading space, which is nearly 600 cubic feet,—being almost double that of the ordinary open goods truck. The cases of damage done to bales of goods, by chafing against the uneven surfaces of the bolts and rivet-heads of the open waggons, has been reduced to one in a thousand cases of those constantly occurring before. The entire build of the waggon is so contrived, that, when once closed, it cannot be entered or taken to pieces, even by the workman who has constructed it, without first obtaining access to the interior,—the whole of the superstructure being fastened from the inside: a lock and bolt of great simplicity are secured on the same principle. One man can open and securely close the new waggon; while several men are required to put the tarpauling on the open waggon.

The inflammable nature of the coverings used for open waggons greatly increases the risk of fire, from cinders falling upon them from the engine, and which would happen daily but for the fortunate circumstance of the wind seldom blowing in a direct line with the progress of the train.

The covered waggon also affords the most remarkable protection to other waggons from being ignited by their proximity to any that may be on fire in the train. Instances have happened on several lines of railway, where property in open waggons, as well as the trucks themselves, have been destroyed. The new covered waggon, if in a train of ordinary waggons on fire, will effectually prevent the flames extending to the next tarpauling, and consequently to the open waggon and its contents. Several instances of the new waggons rendering this service have occurred. One of them contained some thousand pounds' worth of silk; and, in the words of the official report, the contents were not damaged, while the waggon itself was merely charred, and the paint blistered at the end next the fire, which was raging while the train was drawn into the nearest station. In fact, fire occurring in open waggons spreads rapidly,—the flames being very forcibly driven backwards by the speed of the train, and igniting all the waggons behind, if covered with tarpaulings, or open.

The liability to fire is only one of the many objections to the tarpauling covering: it is very liable to be blown about, and sometimes off,—exposing the contents of the waggon to every contingency.

The perfect security now obtained in the transit of the goods in the covered waggons has caused the ordinary insurance of one pound per ton for silk to be discontinued, as also an allowance formerly made to the men for extra care of the goods previously conveyed in open waggons. The object of the writer has been to avoid every known defect of the open waggons, and gradually, as far as practicable, to remove the immediate causes of damage to goods, and loss of waggon service, to reduce repairs as nearly as possible to grease and wheels, and so to improve the construction generally as to adapt it to the varied but well-defined requirements of the railway system. The absence of all claim for damage done to property carried in the new waggon, is a fact that proves some success has attended these efforts.

Further proof of the value of the covered waggon may be inferred from the fact, that the carriers consider their work to be half done when once the goods are deposited in the improved new covered waggon, as compared with the serious responsibility of sending the goods in an open waggon. The carriers stated to the writer that great anxiety is felt until the time has passed for the arrival of the open waggon at its destination, and the delivery of one post; and it is only on the non-arrival of complaint at the period referred to that the carriers begin to feel secure from any claim for damage. The corresponding clerk of one large establishment also reports that he is at a loss to name an amount for the unmistakeable saving effected in correspondence since the covered waggons were first introduced; and more especially as the traffic has increased to an extent not anticipated by the most sanguine. The goods deposited in a covered waggon invariably arrive in precisely the same state as when loaded, free from wet, &c. Some thousands of letters less have come to hand in reference to goods lost and damaged by conveyance in open waggons.

Even with what used to be considered the *ne plus ultra* of the open waggon plan, with that great step in improvement—permanent wood sides and ends—little more security is effected than by crib-rails. This plan can hardly be said to have been subjected to the rule of science at all: it merely consists of certain parts of wood and iron, most unskilfully proportioned to construct a railway waggon,—the sides and ends, forming the superstructure, being boards merely laid horizontally edge to edge, and the standards bolted across the face of the boards, at right angles, leaving all free to work like so many parallel joints. The effect of this mode of building is, that the whole of the parts soon become loose, and, quite as much as the traffic, accelerate the destruction of the waggon.

Another cause of serious expense, attached almost exclusively to the open waggons, is the great danger and outlay incurred by the defective state of the floors, which are found to decay rapidly: the consequence of continual exposure to the different effects of summer and winter. No attention had been directed to the importance of constructing waggon stock to remove this serious defect, until the writer gave it his consideration. He has seen hundreds of the open goods and cattle waggons standing, in winter, with two inches depth of manure and water covering the entire area of the floor, in which holes have afterwards been made to let out the water. One of the greatest practical evils resulting from rotten floors is, the great facility with which the legs of the cattle have slipped through and been broken. The trains have in some instances been thrown from the line, causing much delay and expense. In one or two cases, the beast fell completely through the bottom of the waggon upon the line, whereby the traffic was interrupted, and much damage done. Open merchandise waggons would be the source of many more accidents and greater expense, but for the vigilance of experienced and attentive local examiners of the trains at the stations on the road. The constant expense caused by the exposure of the open waggons to the deteriorating influence of the weather, whether in or out of use, is most serious in amount; as there are several millions' worth of waggon property undergoing depreciation from this cause, for which the companies have to pay a tax equal in amount to that for the employment of the work.

The result of many years' experience has shewn that doors at the end of a waggon are a source of great expense for maintenance; as the ends are subjected to by far the greatest portion of the work, from the violent strains in starting and stopping; and the end doors also cause much inconvenience in working at the stations. The adoption of side-doors was, however, considered objectionable, because the sides of the waggon were then cut completely in two, and rendered weak; but this objection has been got over in the new roofed waggon, in which the sides are fully as strong as the rest. The side sliding doors of the new waggon are always free to move, as well as the moveable portion of the roof: by which valuable provision, the crane chain can deposit or remove a bale of goods, however heavy, from any part of the interior of the waggon. (See Cross Section, Fig. 24.)

In addition to the serious disadvantages of the old open plan of waggons, with which property to a large amount is either stolen, burnt, or damaged by water and other means, there is yet another remarkable circumstance that has not been adverted to. Some waggons contain meat instead of merchandise, and then they not unfrequently become a travelling cooking apparatus, in which cargoes of whole sheep and pigs are roasted, but, what is much more unsatisfactory, spoiled also. The new waggon is not only proof against fire happening to its contents from external causes, but is almost so in reference to its own construction. One of the plans generally adopted is an entire outside skeleton of wood framing, well secured in all its parts by suitable ironwork, and lined on the inside with sheet-iron plates, of No. 16 gauge, which are fixed by screws to the wood scantling. The under side of each plate is bedded upon strips of felt, laid upon the inside of the wood standards, three inches wide. The plates form a flush butt-joint with each other, having a surface bearing of 1½ in. against the framing of the body,—thereby securing a perfectly even and smooth surface of iron over the entire area of the loading space.

The roofs are also made of No. 16 gauge sheet iron, laid upon bent ash ribs, 3×1¾ inches, on the top surface of which are placed strips of tarred felt, 2¾ inches wide, upon which each sheet of iron has a surface bearing of 1¼ inch, and is secured to the rib by screws. It should be observed, that the plates intended to form the roof are so laid as to leave a space of ¼ inch between the edges of each, for the purpose of allowing a screw to pass between the edge of each plate. This space, and the upper surface of each sheet of iron, are, in like manner to the under side, covered by a strip of felt, 2¼ inches wide, upon which is laid transversely a piece of hoop iron of the same width; and this is made to cover the two rows of screws by which the iron roof-plates are made fast to the wood ribs, and is itself secured by a single row of screws, passing between the edges of the plates forming the roof. The cost for maintenance of roofs so constructed is merely nominal,—no case of repair having yet happened (accidents excepted) in five years; while the certain cost of tarpaulings for 500 waggons, during that period, would not be less than £7,500.

The section of the sliding part of the roof and waterways, shewn at fig. 25, will explain the construction of that important part of the new covered waggon. The moveable portion of the roof runs upon rollers of chilled cast iron, accurately turned, and revolving on a steel axle, to prevent wear. The waterway and roller path is partly covered with a flat strip of iron, on which the rollers freely work, and move the slide roof. The plate of iron *a*, answers the purpose of strengthening the wood rib *b*, and effectually prevents any water getting into the interior of the waggon: its surface is also useful for the crane chain to work against, and thereby protects the wood from injury. The whole of the space for the admission of goods is in like manner faced with iron, which renders repair of this part of the waggon most trifling. By this mode of construction, the dimensions of the door-opening and its respective working parts are accurately preserved: consequently, the doors and slide are always found to move easily. The slide *c*, is most effectually prevented from removal for improper purposes, by the external rib *d*, and the iron top plate, secured by a bolt *e*, and a nut on the inside of the sheet-iron roofing, *f*.

Fig. 26, shews a section of one of the sliding side-doors *g*, the side water-way and roller path in which they work, and the inside casing *h*, by which, when out of use, the doors are protected. It also shews the level of the floor-line *i*, and the door-post *j*, faced with a bevilled iron plate *k*, forming also a snap-bolt and nut. All these parts of the waggon have so perfectly answered the purpose for which they were designed, that, after six years' use, the writer is not aware of any alteration that can be made with advantage to the plan.

Mr. Henson exhibited a drawing of a covered waggon of similar construction to that explained above, except that the doors on both sides, and the corresponding part of the roof, are framed together, and move longitudinally either to the right or left. He likewise exhibited sections of four other plans of moving roofs. The first is suitable for a goods waggon where sliding doors on each side are requisite, and is formed of two slides, moving transversely upon the waggon, one above the other. In the second plan, the slide runs longitudinally in grooves upon the top of the waggon, and is applicable to such as have doors at the end. The third is on the same principle, with the exception that the slide moves upon an iron rod on each side of the roof, and is kept in its place by eye-bolts, through which the rods pass. In the fourth plan, the sliding part of the roof is in two parts, which move longitudinally to the right and left: this arrangement is suited to waggons that are required to have folding doors on each side.

There are several modifications of the plan of building these improved waggons; but the one shewn in fig. 23, and another in which deal boards are used, instead of the iron plates, to form the body, as before described, are those generally adopted. The roof is in all cases formed of sheet-iron, painted.

The subject of dead weight, as compared with the load carried, is of importance. The original waggons weighed from 2 to 2¾ tons; and the load was about the same. The present open waggons weigh 3½ tons; and the load is 4½ tons;—being 1 ton in favor of paying weight. The new covered waggons weigh 3½ to 5 tons; a few only, with iron floors, and heavy axle-boxes and wheels, weigh 5 tons; but the general class weigh 4 tons,—carrying 6 to 8 tons. The exact weight of the present build would be 3½ tons: load, 6½ tons. Paying weight, as compared with dead weight, 3 tons gained. The general class of low-sided waggons weigh from 2½ to 4 tons,—carrying 2½ to 4½ tons. The general class of high-sided waggons weigh from 2¾ tons to 4 tons 2 cwt.: load, 3½ to 4½ tons.

Mr. Henson exhibited a working model of his improved covered waggon. In reply to some questions from Mr. Slate, he stated that the waggon would take to the amount of from five to seven tons of sugar, silks, &c., and other damageable goods. These waggons were calculated for the conveyance of Manchester goods, which were generally heavy; and they were found by the carriers particularly serviceable in carrying, with perfect security, these descriptions of damageable goods. Sheet and hoop iron would also load them to seven tons: these goods required substantial covering, to protect them from rust and other injuries; and serious loss was sometimes experienced from the damage caused to them by exposure to the weather in the ordinary open waggons.

Mr. Slate observed, that in Mr. Henson's waggon the reduction of the tare was certainly very considerable. It appeared he had produced a vehicle which, for every ton of its own weight, would carry double the weight of goods. This was a great step in the right direction, and he hoped the waggon might be further enlarged and improved—even to double its size—that expenses might be saved, and a reduction in the carriage of heavy goods be effected.

Mr. Henson replied, that the great objection to any extension of the length of the waggons was, the manner in which they were now confined by the station buildings, the approaches to the warehouses, and the turn-tables. Great alterations would be required at the stations, along the whole line of railway, before any enlargement of the present size of waggons could take place.

Mr. W. Smith said, that it was clear that the waggon possessed every facility for loading all kinds of goods. He saw that certain parts of the new waggon were made of corrugated iron; and he wished to inquire where the extra strength and saving in weight were obtained; and why the framing and the platform were not also made of iron instead of wood?

Mr. Henson explained, that he considered the combination of wood and iron that he had adopted was decidedly the best. In his opinion, an entire iron waggon would not only be heavier, but it would be weaker; while, at the same time, it would be considerably more expensive, and more difficult to repair. The wood prevented the iron from bending, and the iron prevented the wood from breaking; and, by these means, a great increase of strength was obtained.

Mr. W. Smith suggested that the waggons should have iron sides and ends entirely, as well as iron tops, if the object were to protect the goods against the effects of fire; as protection was quite as necessary in that part of the carriage, when a train was on fire, as it was on the roof.

The Chairman observed, that he could bear testimony to the new waggon being an effective security against fire. In his own experience, he had known it operate, when placed between two of the old waggons, as a complete check against the progress of fire in a goods train on the railway.

Mr. Slate (referring to the model of the new waggon) shewed the great additional strength which the roof, from its construction, gave to the body of the waggon, as compared to an open waggon. The frame acted as diagonal bracing; while the roof, like the deck of a ship, strengthened the general structure of the vehicle.

Mr. Cowper observed, that the roof of the waggon made the whole body, as regarded strength, into a complete girder, of the full depth of the waggon.

Mr. Adams quite agreed with Mr. Henson, with regard to the objection to iron for the upper framing; there would be great difficulty in rivetting corrugated iron to iron framing, and such a process would necessarily lead to considerable expense; but it was comparatively easy to fix the corrugated iron by screws to wood framing. He was of opinion, however, that iron was better for the under framing than wood. He considered that the waggon, as constructed, was very safe from fire; and if, with a dead-weight of only 3½ tons it could carry 6 or 7 tons of goods, it was most unquestionably a very efficient vehicle.

The Chairman said, the protection against fire went far to shew the superiority of Mr. Henson's waggon; and, when they considered the great losses to which railway companies were subjected, by damage done to goods entrusted to them for conveyance, it was evident that advantages were derivable from efficient protection, by having the waggons completely closed, and, as nearly as possible, air-tight. It would also be a great saving to railway companies, in reducing the proportion of the dead-weight of the waggons, as compared to the paying weight carried; and, in addition to the protection from injury and loss, the expense of goods conveyance would be considerably reduced, and the means of carriage increased.

List of Patents

That have passed the Great Seal of IRELAND, from the 17th June to the 17th September, 1851, inclusive.

To Thomas Marsden, of Salford, for improvements in machinery for hackling and combing flax and other fibrous materials.—Sealed 2nd July.

William Melville, of Roebank Works, Lochwinnoch, in the county of Renfrew, North Britain, calico printer, for certain improvements in manufacturing and printing carpets and other fabrics.—Sealed 10th July.

Thomas Allan, of the City of Edinburgh, Gent., for certain improvements in electric telegraphs, and in apparatus connected therewith.—Sealed 23rd July.

William Beadon, jun., of Taunton, in the county of Somerset, Gent., for improvements applicable to the roofing of houses, buildings, and other structures.—Sealed 2nd August.

David Ferdinand Masnata, of Golden-square, Regent-street, in the county of Middlesex, Gent., for a new mechanical system with compressed air, adapted to obtain a new moving power.—Sealed 9th August.

Hugh Barclay, of 170, Regent-street, in the county of Middlesex, Gent., for improvements in the means of extracting or separating fatty and oily matters; in refining and bleaching fatty matters and oils, animal and vegetable wax and resins; and in the manufacture of candles and soap,—being a foreign communication.—Sealed 11th August.

James Whitelaw, of Johnstone, in the county of Renfrew, North Britain, engineer, for improvements in steam-engines.—Sealed 22nd August.

William Mather and Colin Mather, of Salford, in the county of Lancaster, engineers, and Ferdinand Kaselowsky, of Berlin, in the Kingdom of Prussia, engineer, for improvements in machinery for washing, steaming, drying, and finishing cotton, linen, and woollen fabrics.—Sealed 5th September.

David Farrar Bower, of Hunslet, in the parish of Leeds, in the county of York, manufacturing chemist, for certain improvements in preparing, rating (otherwise called rotting), and fermenting flax, line, grasses, and other fibrous vegetable substances.—Sealed 8th September.

William Johnson, of Millbank, in the City of Westminster, Gent., for improvements in apparatus for weighing goods.—Sealed 9th September.

List of Patents

Granted for SCOTLAND, subsequent to 22nd July, 1851.

To William Johnson, of the Office for Patents, 47, Lincoln's-inn-fields, London, and 166, Buchanan-street, Glasgow, civil engineer, for improvements in machinery or apparatus for the manufacture of envelopes,—being a communication.—Sealed 23rd July.

Daniel Towers Shears, of Bankside, Southwark, copper merchant, for improvements in the manufacture and refining of sugar,—being a communication.—Sealed 25th July.

Alexander Alliott, of Lenton, in the county of Nottingham, engineer, for improvements in cleaning, dyeing, and drying machines; and in machinery to be used in sugar, soap, metal, and color manufacturing.—Sealed 31st July.

John Davie Morries Stirling, of Blackgrange, North Britain, for improvements in the manufacture of metallic sheets, and coating metals and alloys of metals; in metallic compounds; and in welding.—Sealed 31st July.

James Whitelaw, of Johnstone, Renfrewshire, engineer, for certain improvements in steam-engines.—Sealed 1st August.

Robert Oxland and John Oxland, of Plymouth, chemists, for improvements in the manufacture and refining of sugar.—Sealed 6th August.

Charles Cowper, of 20, Southampton-buildings, Chancery-lane, London, for certain improvements in piling, fagotting, and forging iron and steel for plates, bars, shafts, axles, tyres, cannons, anchors, and other similar purposes,—being a communication.—Sealed 6th August.

Peter Robert Drummond, of Perth, for improvements in churns. Sealed 6th August.

James Buchanan Mirrlees, of Glasgow, engineer, for certain improvements in machinery, apparatus, or means for the manufacture or production of sugar.—Sealed 8th August.

Joseph Mansell, of Red Lion-square, London, manufacturing fancy stationer, for improvements in ornamenting paper and other fabrics.—Sealed 8th August.

William Onions, of Southwark, engineer, for improvements in the manufacture of certain parts of machinery used in spinning.—Sealed 11th August.

Alphonse Rene le Mire de Normandy, of Judd-street, London, and Richard Fell, of the City-road, London, engineer, for improved methods of obtaining fresh water from salt water; and of concentrating sulphuric acid.—Sealed 13th August.

David Farrar Bower, of Hunslet, in the parish of Leeds, manufacturing chemist, for certain improvements in preparing, rating (otherwise called rotting), and fermenting flax, line, grasses, and other fibrous substances.—Sealed 20th August.

Dominique Julian, of Sorgues, France, for improvements in extracting the coloring properties of madder, and in rendering useful the water employed in such processes.—Sealed 25th August.

George Jordan Firman, of Lambeth-street, Goodman's-fields, London, manufacturing chemist, for improvements in the manufacture of oxalate of potash.—Sealed 25th August.

Thomas Wilks Lords, of Leeds, flax and tow machine maker, and George Wilson, director of the flax works of John Fergus, of Prenlaws, Fifeshire, M.P., for a machine to open and clean tow and tow-waste from flax, and hemp, and other similar fibrous substances; and an improved mode of piecing straps and belts for driving machinery; and a machine for effecting the same,—being a communication.—Sealed 27th August.

Richard Fletcher, of Blackdowns Farm, in the parish of Ebrington, Gloucestershire, farmer, for an improvement in obtaining motive power.—Sealed 29th August.

Henry Dircks, of Moorgate-street, London, engineer, for improvements in the manufacture of gas, in gas-burners, and in apparatus for heating by gas.—Sealed 1st September.

Richard Archibald Brooman, of Fleet street, London, patent agent, for an improved method of manufacturing screws,—being a communication.—Sealed 8th September.

New Patents

SEALED IN ENGLAND.

1851.

To Pierre Armand Le Comte de Fontainemoreau, of 4, South-street, Finsbury, in the county of Middlesex, for certain improvements in apparatus for gas-lighting,—being a communication. Sealed 28th August—6 months for inrolment.

John Wallace Duncan, of Grove-end-road, St. John's Wood, Gent., for improvements in engines for applying the power of steam or other fluids for impelling purposes; and in the manufacture of appliances for transmitting motion. Sealed 4th September —6 months for inrolment.

Henry Alfred Jowett, of Sawley, in the county of Derby, engineer, and John Kirkham, of Peckham, in the county of Surrey, engineer, for improvements in hydraulic telegraphs, and in making signals. Sealed 4th September—6th months for inrolment.

John Poad Drake, of St. Austell, in the county of Cornwall, for improvements in constructing ships and other vessels, and in propelling ships and other vessels. Sealed 4th September—6 months for inrolment.

Dominique Julian, of Sorgues, France, for improvements in extracting the coloring properties of madder, and in rendering useful the water employed in such processes. Sealed 4th September—6 months for inrolment.

Baron Charles Wetterstedt, of Grosvenor-street, Commercial-road, for improvements in preserving animal and vegetable substances. Sealed 4th September—6 months for inrolment.

William Imray, of Milton-road, Liverpool, for improvements in the manufacture of bricks,—being a communication. Sealed 4th September—6 months for inrolment.

Timothy Kenrick, of the parish of Edgbaston, in the county of Warwick, iron-founder, for improvements in the manufacture of wrought iron tubes. Sealed 4th September—6 months for inrolment.

Benjamin Hallewell, of Leeds, wine merchant, for improvements in drying malt. Sealed 4th September—6 months for inrolment.

Pierre Armand Le Comte de Fontainemoreau, of South-street, Finsbury, for certain improvements in preserving animal substances from decay, by means of a composition applicable to the cure of certain diseases. Sealed 4th September—6 months for inrolment.

Gail Borden, jun., of Galveston, Texas, in the United States of America, manufacturer, for improvements in the treatment of certain animal and vegetable substances, to render them more convenient for use as articles of food, and for their better preservation. Sealed 5th September—6 months for inrolment.

John Blair, of Irvine, in the county of Ayr, N. B., Gent., for certain improvements in beds or couches, and other articles of furniture. Sealed 10th September—6 months for inrolment.

John Rowland Crook, of Birmingham, in the county of Warwick, hatter, for improvements in hats, caps, and bonnets. Sealed 11th September—6 months for inrolment.

David Main, of Beaumont-square, in the county of Middlesex, engineer, for improvements in steam-engines and in furnaces. Sealed 11th September—6 months for inrolment.

William Jean Jules Varillat, of Rouen, in the Republic of France, manufacturing chemist, for improvements in the extraction and preparation of coloring, tanning, and saccharine matters from various vegetable substances, and in the apparatus to be employed therein. Sealed 11th September—6 months for inrolment.

Alexander Parkes, of Birmingham, in the county of Warwick, chemist, for certain improvements in the manufacture of copper, and in the separation of some other metals therefrom, and in the production of alloys of certain metals. Sealed 11th September—6 months for inrolment.

George Phillips, of Upper Park-street, Islington, in the county of Middlesex, chemist, for preventing the injurious effects arising from the smoking of tobacco. Sealed 18th September —6 months for inrolment.

John Wormald, of Manchester, in the county of Lancaster, maker-up and packer, for improvements in machinery or apparatus for spinning and doubling cotton, wool, silk, flax, or other fibrous substances. Sealed 18th September—6 months for inrolment.

John Simpson Leake, of Whitehall Salt Works, in the county of Chester, manufacturer, for certain improvements in the processes and machinery or apparatus employed in the manufacture of salt. Sealed 18th September—6 months for inrolment.

John Livesey, of New Lenton, in the county of Nottingham, draughtsman, for improvements in the manufacture of textile fabrics, and in the machinery for producing the same. Sealed 18th September—6 months for inrolment.

Frederick Hale Thomson, of Berners-street, in the county of Middlesex, Gent., and **George Foord**, of Wardour-street, in the same county, chemist, for improvements in bending and annealing glass. Sealed 25th September—6 months for inrolment.

Charles Green, of Birmingham, in the county of Warwick, for improvements in the manufacture of brass tubes. Sealed 25th September—6 months for inrolment.

Richard Archibald Brooman, of Fleet-street, London, for improvements in presses, and in pressing,—being a communication. Sealed 25th September—6 months for inrolment.

Robert Roberts, of Dolgelly, in the county of Merioneth, mine agent, for an improved method of quarrying certain substances. Sealed 25th September—6 months for inrolment.

Charles Watt, of Kennington, in the county of Surrey, chemist, for improvements in the decomposing of saline and other substances, and in separating their component parts, or some of them, from each other; also in the forming of certain compounds or combinations of substances; and also in the separating of metals from each other, and in freeing them from impurities. Sealed 25th September—6 months for inrolment.

James Garforth, of Dukinfield, in the county of Chester, engineer, for certain improvements in locomotive steam-engines. Sealed 25th September—6 months for inrolment.

David Stephens Brown, of the Old Kent-road, in the county of Surrey, Gent., for an improved agricultural implement. Sealed 25th September—6 months for inrolment.

Ernst Kaemmerer, of Bromberg, in the Kingdom of Prussia, iron-founder, for improvements in sowing, depositing, or distributing seeds over land. Sealed 25th September—6 months for inrolment.

CELESTIAL PHENOMENA FOR OCTOBER, 1851.

D.	H.	M.	
1			Clock after the ☉ 10m. 12s.
—			☽ rises 1h. 30m. A.
—			☽ pass mer. 5h. 36m. A.
—			☽ sets 9h. 39m. A.
2			Occul. B.A.C. 6607, im. 5h. 45m. em. 7h. 7m.
	2	30	☽ in □ or first quarter
3	14	25	Pallas stationary
4	7	28	Ceres in □ with the ☉
5			Clock after the ☉ 11m. 26s.
—			☽ rises 4h. 15m. A.
—			☽ pass mer. 8h. 53m. A.
—			☽ sets 0h. 34m. M.
	3	9	☿ in Perihelion
7	6		☿ greatest elong. 17. 56. W.
	7		☽ in Apogee
10			Clock after the ☉ 12m 51s.
—			☽ rises 5h. 57m. A.
—			☽ pass mer. morn.
—			☽ sets 6h. 0m.
	6	33	Ecliptic oppo. or ○ full moon
	23	49	♄ in conj. with the ☽ diff. of dec. 2. 19. N.
11	0	29	♅ in conj. with the ☽ diff. of dec. 4. 40. N.
12	8	48	Ceres in the ascending node
13			Occul. δ^1 Tauri, im. 17h. 57m. em. 18h. 55m.
15			Clock after the ☉ 14m. 4s.
—			☽ rises 8h. 12m. A.
—			☽ pass mer. 3h. 30m. M.
—			☽ sets 11h. 37m. M.
—			Occul. χ^1 Orionis, im. 9h. 19m. em. 9h. 25m.
	11	8	☿ greatest hel. lat. N.
16			Mercury, R. A., 12h. 31m. dec. 1. 16. S.
—			Venus, R. A., 13h. 40m. dec. 9. 24. S.
—			Mars, R. A., 7h. 55m. dec. 21. 55. N.
—			Vesta, R. A., 18h. 16m. dec. 25. 14. S.
—			Juno, R. A., 17h. 35m. dec. 12. 17. S.
16			Pallas, R. A., 3h. 45m. dec. 20. 56. S.
—			Ceres, R.A., 6h.57m.dec. 22.59.N.
—			Jupiter, R. A., 13h. 57m. dec. 10. 53. S.
—			Saturn, R. A., 2h. 1m. dec. 9. 25. N.
—			Uranus, R. A., 2h. 3m. dec. 11. 57. N.
—			Mercury pass mer. 22h. 56m.
—			Venus pass mer. 0h. 3m.
—			Mars pass mer. 18h. 16m.
—			Jupiter pass mer. 0h. 19m.
—			Saturn pass mer. 12h. 21m.
—			Uranus pass mer. 12h. 23m.
17	18	21	♂ in conj. with the ☽ diff. of dec. 36. N.
18	0	13	☽ in □ or last quarter
20			Clock after the ☉ 15m. 3s.
—			☽ rises 0h. 25m. M.
—			☽ pass mer. 8h. 7m. M.
—			☽ sets 3h. 34m. A.
	4	53	♀ in conj. with ♃ diff. of dec. 0. 11. S.
	20		☽ in Perigee
23	7	59	☿ in conj. with the ☽ diff. of dec. 3. 39. S.
	14	42	♂ in □ with the ☉
24	3	10	Ecliptic conj. or ● new moon
	4	23	♃ in conj. with the ☽ diff. of dec. 4. 10. S.
	8	13	♄ opposition to the ☉
	11	43	♀ in conj. with the ☽ diff. of dec. 4. 22. S.
25			Clock after the ☉ 15m. 46s.
—			☽ rises 7h. 24m. M.
—			☽ pass mer. 0h. 38m. A.
—			☽ sets 5h. 41m. A.
	22		♅ opposition to the ☉
26	22	22	♃ in conj. with the ☉
30			Clock after the ☉ 16m. 11s.
—			☽ rises 1h. 7m. A.
—			☽ pass mer. 5h. 12m. A.
—			☽ sets 9h. 19m. A.
31	7	18	☽ in □ or first quarter

Eclipses of Jupiter's Satellites are not visible this month,—Jupiter being too near the sun.

J. LEWTHWAITE, Rotherhithe.

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CONJOINED SERIES.

No. CCXXXIX.

THE INDUSTRIAL EXHIBITION.

GENERAL REMARKS.

After five months of unexampled success, the world-wide wonder of the present age has closed for ever to the eager multitudes who were hoping to repeat again and again their farewell visit to those congregated treasures of the industrial world, which, while we write, are finding their way into new regions, bearing a value far above their intrinsic worth, from having found a temporary resting place in the Crystal Palace. Never, perhaps, was an event at once so desired and regretted as the closing of the Great Exhibition. To the contributors it was truly a great boon; while, by visitors, it was condemned as altogether impolitic and uncalled for; we think, however, that the Royal Commissioners have acted wisely in keeping to their promise. Consequent on the cessation of the excitement created by the Exhibition itself, another matter of interest has arisen, which bids fair to tide us well over the present year in one continuous whirl of uproar; for, no sooner were the formalities of the closing scene enacted, and the decisions of the Juries made known, than thousands of malcontent exhibitors were busy denouncing the partiality and injustice of the awards. This has no doubt arisen from the culpable negligence of the Executive Committee in not announcing the principle upon which rewards would be bestowed. Many months before the opening of the Exhibition we had ourselves put forth a plan which (whatever might have been its faults) at least possessed comprehensible substantiality, and would, if acted upon, have prevented the possibility of a tobacco pipe carrying off as great a reward as a mariner's compass, which compensates for local attraction, or a chronometer, whose variable uncompensated rate between the extremes of temperature noted by 10° and 110°, is set down by Professor Airey as a gain of 0.0269″ only, in contrast with two good government chronometers, which, respectively, lost 0.963″ and gained 0.520″. The award of prizes has, in fact, from the commencement of the enterprise, been looked upon by many competent judges as a false step; and the substitution of medals for sums of money (which were at first talked of) was deemed a lessening merely of the evil. For our own part, we do not go so far, but think that, if a definite plan had been determined on, and made known to the exhibitors, a far more satisfactory result would have been arrived at in the distribution of the rewards than is now attained: the decisions must, we presume, be considered as irrevocable; and, therefore, it is the wisest course for dissatisfied exhibitors to hide their chagrin as best they may, hoping that, should the experiment be repeated at a future day, the experience of the past will not be forgotten.

Reverting to our own proceedings, in connection with the Exhibition, we may remark, that, in the present number, under the head of *Raw Materials*, the manufacture of soda is treated of; and also, what is near of kin to it, soap making. In this latter branch of industry, we have a remarkable example of the pernicious effect of that remanet of a barbarous policy—the Excise, which at once invades the liberty of the subject, and puts a veto upon improvement.

We, this month, complete our examination of *Musical Instruments*, treating particularly of free-reed instruments and harps, and touching generally on those wind and stringed instruments which have not been previously noticed.

Under the head *Agricultural Implements*, the following subjects are reviewed, viz., digging machines, clod-crushers, harrows, scarifiers, and cultivators, which, with the various constructions of ploughs previously noticed, complete our examination of the implements used in preparing the soil for the reception of seed.

Textile Manufactures is, this month, continued for the purpose of bringing under notice the ingenious machinery employed in treating flax from the state of straw, and converting it into yarn.

In our next number it is proposed to close, with the year, our review of the Exhibition; and to offer some comments upon the effect which it is calculated to produce upon the industrial and social condition of the world.

RAW MATERIALS.

THE MANUFACTURE OF SODA.

Few of the millions who lately thronged the avenues of the Crystal Palace can fail to have noticed the magnificent specimens of carbonate of soda displayed in several departments of the Great Exhibition. These specimens possess an interest superior to that of the Koh-i-noor, or the Queen of Spain's Jewels; for they are illustrations of the present condition of the soda trade, which furnishes, perhaps, the most remarkable evidence on record of the immense advantages which the science of chemistry is capable of conferring upon the manufacturing industry of a nation. From being the largest importers of soda in Europe, we have become, in little more than a quarter of a century, its largest exporters; from depending wholly upon others for a limited and variable supply of this essential article, we are now able to deluge every market in the known world with our superfluous produce; and from witnessing the most ruinous fluctuations in its price, we have, for many years, seen soda gradually and steadily decline to a value which has brought it within the sphere of many branches of industry, from which, within the memory of even young individuals, it was once altogether excluded. Such are the benefits resulting from a correct application of science. Soda, under the term nitron,* or natron, seems to have been used in the earliest ages—a circumstance no doubt connected with the fact, that it occurs native in many parts of the world; as, for example, in Syria, Egypt, Arabia, Thibet, India, China, Hungary, Siberia, and South America. The chief source of soda, however, from the days of the elder Pliny to a very recent period, was derived from the combustion of sea plants, of the species algæ, together with the salsola soda and salicornia herbacea, plants naturally growing on the shores of the Mediterranean, but extensively cultivated on the southern coasts of Spain for the production of impure soda, or barilla, as it was commercially called. The incineration of these plants furnished a hard, semivitrified mass, of a dark-grey color, with a shade of blue, from which, by lixiviation and crystallization, about one-fourth or one-fifth of its weight of carbonate of soda might be obtained. It is, however, useless to enter into a minute description of this manufacture, as the only really important facts connected with it will, with more propriety, engage our attention in speaking of the fabrication of iodine. For the present, therefore, we quit the subject of barilla, and its sub-species kelp, and proceed to investigate the modern art of manufacturing soda. The first step in this process has reference only to the production of sulphate of soda; for it is by the subsequent decomposition of this salt that the carbonate of soda is procured. To obtain sulphate of soda, the soda-maker throws into a kind of closed oven or furnace a determined quantity of common salt, or chloride of sodium, upon which a small stream of sulphuric acid is allowed to fall gradually; the mixture being continually raked about by a workman who is provided with a long-handled iron rake for this purpose. The chloride of sodium, and the hydrated sulphuric acid, mutually react upon each other,—the water of the acid being decomposed at the same time. In this way the oxygen of the water passes to the sodium, forming soda; whilst its hydrogen combines with the chlorine to produce hydrochloric or muriatic acid. The soda instantly unites to the sulphuric acid, thus generating sulphate of soda, which remains on the floor of the furnace as a white friable mass; whereas, the hydrochloric acid is expelled by the heat, and passes into the flue or chimney. It was long customary to permit the escape of this hydrochloric acid as a waste product; and this is still done in some localities at the present day. But independently of the actual loss thus caused, the injurious action of the acid fumes upon every form of vegetation for many miles around the manufactory, has compelled the makers of soda to condense this hydrochloric acid by passing it through flues filled with coke, over the cavernous surface of which a small stream of water constantly flows. In this way, a large quantity of liquid muriatic acid is procured, which, though too impure for many of the ordinary requirements of the arts, is yet admirably adapted for the generation of chlorine, and the subsequent manufacture of chloride of lime, concerning which we shall, by-and-bye, offer a few observations. The total worth of this waste product may be gathered from the fact, that in one large soda works near Glasgow, sufficient muriatic acid is collected to yield 8000 tons of chloride of lime per annum, and yet this scarcely represents one-twentieth of the soda manufacture of Great Britain. Having in this way obtained a quantity of sulphate of soda, the soda-maker now proceeds to his next operation. Here, however, it may be as well to remark, that the sulphate of soda in question is not nearly pure, but usually contains from five to ten per cent. of common salt, which has escaped decomposition in the sulphate-furnace; as it is more economical to leave a small excess of chloride of sodium than to add a superfluity of sulphuric acid,—since this latter is vastly more expensive than the former; and the presence of common salt is rather beneficial than otherwise during the subsequent process. To convert this impure sulphate of soda into carbonate of soda, it is mixed in about equal proportions with chalk or carbonate of lime and small coals, all in a state of rough powder. The mixture, merely thrown together with shovels, is projected into a reverberating furnace called the ball-furnace, where it is stirred about with a long iron paddle until it undergoes an imperfect fusion; and long jets of yellow flame, technically called "candles," burst out from various parts of the mass, which, for an ordinary charge of three or four hundred-weight, will require about three hours. The whole is then raked out, and allowed to cool—the furnace being supplied, as before, with a fresh charge of materials. The product of this operation is known as ball-soda, and it consists of carbonate of soda, sulphuret of sodium, chloride of sodium, undecomposed sulphate of soda, carbonate of lime, sulphuret of calcium, and carbon or coke. We have had an opportunity of examining several specimens from the largest manufactories in the kingdom, and find no great difference in the results. The average composition appears to be as under:—

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* The term Νιτρον was perverted in the middle ages into natrum, or natron, whilst the real word Νιτρον came improperly to signify nitre, or saltpetre. But the ancients were unacquainted with nitre; and the word natrum never occurs in the works of the Greeks or Romans, nor, indeed, in those of the best writers of the middle ages. Nitre seems to have been unknown in Europe till about the epoch of the invention of gunpowder; and a curious illustration of the error arising from this corruption of names may be seen in the ordinary translation of the Scriptures. The 20th verse of the 25th chapter of Proverbs is thus rendered: "As he who taketh away a garment in cold weather, and as vinegar upon *nitre*, so is he that singeth songs to a heavy heart." Now, the beauty of this second simile is here altogether destroyed,—for vinegar has no action whatever upon nitre; but if for this we substitute the modern expression natron, or carbonate of soda, the force and correctness of the metaphor become immediately obvious; for vinegar and natron are incompatible substances.

Soda	19·80
Carbonic acid	9·24
Sulphuret of sodium	2·64
Chloride of sodium	5·22
Sulphate of soda	6·10
Sulphuret of calcium	29·40
Carbonate of lime	21·70
Coke	5·90
	100·

We shall describe the mode of analyzing this compound a little further on; but, at this moment, it will be more advantageous to pursue the remainder of the operation for procuring carbonate of soda from the cooled product of the ball-furnace. This substance, under the name ball-soda, is roughly broken to pieces, and piled up in a large iron tank, provided with a false bottom or grating, and having an aperture near the bottom. When the tank is full, the aperture near the bottom is plugged up, and hot water run upon the ball-soda to within an inch or two of the top of the tank. The whole is allowed to remain for several hours; by which, the salts of soda—consisting, as we have seen, of carbonate and sulphate of soda, with the chloride and sulphuret of sodium—are dissolved; the plug is then withdrawn, and the soluble matters are allowed to flow away from the carbonate of lime, sulphuret of calcium, and coke, which are insoluble. Upon these latter a fresh portion of hot water is poured, so as thoroughly to remove the soda salts; and this last solution is commonly applied to a quantity of new ball-soda, in order to economize the cost of evaporation. The first fluid from the tank is conducted at once into a reverberatory furnace, where the water is rapidly expelled, and a dry saline product obtained. This is immediately transferred to what is called the carbonating furnace, where the sulphuret of sodium is partly decomposed by the carbonic acid of the furnace, and partly reconverted into sulphate of soda by the oxygen of the air. Meantime, the portion of soda existing in the mass as caustic soda, becomes carbonated by the carbonic acid of the fire; and hence the name of this particular furnace. Having been kept at a dull red heat, but short of that required for actual fusion, the whole is withdrawn and cooled; after which, it is boiled in water, and the concentrated solution run off into shallow coolers to crystallize. As the saline constituents now consist almost entirely of carbonate of soda, with a little sulphate of soda and chloride of sodium, the former salt crystallizes and becomes solid; leaving the two latter, with a portion of carbonate of soda, in solution. The crystals are taken out, dried, and packed for the market; whilst the residuary solution is evaporated to dryness, and the result sold under the name of soda-ash,—though this name is sometimes also applied to the direct product of the carbonating furnace. The nature of the decomposition, which takes place in the ball-furnace, may be very correctly inferred from the composition of the products thence ensuing. We have seen that the primary mixture is composed of sulphate of soda, carbonate of lime, and carbon. On exposing these to a red heat, sulphuret of sodium is generated, which immediately acts upon the carbonate of lime, producing sulphuret of calcium and carbonate of soda. As, however, during the reduction of the sulphate of soda, part of the carbonate of lime is rendered caustic by the expulsion of its carbonic acid, this caustic lime makes its appearance in the ball-soda tank, and converts a portion of the carbonate of soda into caustic soda: hence the necessity for the carbonating furnace, which is, moreover, useful in destroying the sulphuret of sodium.

We shall now proceed to describe the mode of analyzing ball-soda; after which, it will be necessary to review the whole process of soda-making, with a view to the possibility of improvement.

Having selected a fair sample of the ball-soda to be examined, this must be reduced to an extremely fine powder; and a given weight of it—say 100 grs., digested in two ounces of hot water for ten or fifteen minutes; then throw the whole on a filter, and wash this gradually with three ounces of boiling water, taking care to add these washings to the first liquid which passed through the filter. The filter, with its insoluble contents, may now be set in a warm place to dry. Meanwhile, the clear solutions being mixed, are to be treated with finely-powdered carbonate of lead, until this ceases to be blackened; when this occurs, the heavy black precipitate of sulphuret of lead is allowed to settle, and the clear colorless solution is poured off into a porcelain bason. A little warm water is now to be thrown upon the sulphuret of lead; and, when this has again settled, the clear fluid must be withdrawn and added to that in the porcelain bason. This being gently heated, must next be treated by a dilute acid of a determinate strength, until litmus paper, on being dipped into it, becomes slightly reddened; when the amount of soda present, or of carbonate of soda, may be inferred, in the usual way, from the consumption of dilute acid. The sulphuret of lead remaining from this operation is now to be supersaturated with acetic acid, and slightly heated, for the purpose of removing from it any excess of carbonate of lead that may have been added in the first instance; the sulphuret of lead must then be well washed with hot water, dried and weighed. Every 120 grs. represent 40 grs. of sulphuret of sodium, and for this, 32 grs. of soda must be deducted from the result of the acidulous assay. The insoluble matter remaining on the filter is now to be transferred to a double-necked bottle, provided with a bent tube, for passing the evolved gases through a solution of the acetate of lead in weak acetic acid. This insoluble matter consists of carbonate of lime, sulphuret of calcium, and coke; if, therefore, diluted muriatic acid is poured upon it, the two former substances will be decomposed with the evolution of carbonic acid and sulphuretted hydrogen, the latter of which is absorbed by the acidulous solution of the acetate of lead, whilst the carbonic acid passes on and escapes. In combining with the solution of acetate of lead, the sulphuretted hydrogen gives rise to the formation of sulphuret of lead, which, being well washed with hot water, then dried and weighed, gives the amount of sulphuret of calcium existing in the residue: for every 120 grs. of sulphuret of lead indicate 84 of sulphuret of calcium. The fluid in the two-necked flask consists of chloride of calcium, with the coke of the ball-ash. This must, therefore, be thrown on a filter, and well washed with hot water, and dried: the coke may then be separated and weighed. As from the existence of carbonate of soda in the first solution, neither lime nor its sulphate could exist in the insoluble matter, if this had been weighed previously to these latter experiments, the difference in weight, after deducting the sulphuret of calcium and the coke, will be that of the carbonate of lime; and this, under the circumstances, is sufficiently correct in moderately skilful hands. It now remains, therefore, only to determine the quantity of chloride of sodium and sulphate of soda present in the ball-soda. For this purpose, 100 grs. of the finely-powdered compound are to be treated exactly as before, with hot water and carbonate of lead. In this case, however, the resulting alkaline solution must be supersaturated with pure nitric acid, and to this an excess of nitrate of silver must be added, and the mixture warmed. A dense, coagulated precipitate will fall, from which the clear solution being poured off into a proper vessel, the precipitate is to be washed with a little boiling distilled water, and the washings added to the clear solution before mentioned. The precipitate being now well dried in a dark place, must be weighed; and for every 144 grs. of this precipitate, 60 grs. of chloride of sodium must be assumed. To the clear solution resulting from this operation, an excess of nitrate of baryta must be thrown in, and the mixture slightly heated as before, and then thrown on a previously-weighed filter. This filter, when the solution has passed. is to be repeatedly washed with boiling distilled water, until this fluid passes through pure; the filter is then to be well dried and weighed, to ascertain its increase of weight. This increase is due to the presence of sulphate of baryta, for every 117 grs. of which, 72 grs. of sulphate of soda must have existed in the portion of ball-soda examined.

To determine the amount of carbonic acid combined with the soda, a given quantity (and for this purpose 50 grs. is enough) of the finely-powdered ball-soda must be lixiviated as before, and the clear solution boiled down to dryness with an excess of pure peroxide of manganese,—the whole being at last slightly heated over the fire. By the action of the manganese at this heat, the sulphuret of sodium is converted into sulphate of soda; and if the soda salts be now dissolved in a small quantity of water, and the solution placed in a proper flask, provided with a bent tube, containing chloride of calcium, to arrest moisture, the carbonic acid may be expelled by a known weight of diluted sulphuric acid; and presuming the flask and the vessel containing the dilute acid to have been carefully weighed before and after the experiment, the loss gives at once the weight of the carbonic acid united to the soda. This appears never to be equivalent to the amount of soda. There is a circumstance connected with the lixiviation of ball-ash, on the large scale, which has probably escaped the attention of manufacturers, but is of considerable importance towards securing a successful result. The general practice is to employ hot water for dissolving out the soda salts, and to retain this solution in contact with the insoluble residue for several hours. Theoretically, this is incorrect, and, practically, we have found it injurious. Sulphuret of calcium, though an insoluble salt, is not absolutely so; and the moment this substance in solution comes in contact with carbonate of soda, double decomposition ensues, attended with the production of carbonate of lime and sulphuret of sodium —a process exactly the reverse of that which happens under the influence of a red heat, and of which, in chemistry, there are many other examples. Thus it constantly happens that sulphuret of sodium is found in the lixiviated products of ball-soda. If, however, cold water be employed, and the contact of the carbonate of soda with the sulphuret of calcium be considerably diminished, as with great ease may be done, by coarsely powdering the ball-soda, instead of employing it in lumps, then the clear solution is almost entirely free from sulphuret of sodium, and is devoid of color; whereas, by the hot-water process, this fluid is invariably of a dirty-green hue, and has an offensive odour of sulphuretted hydrogen. Now, remembering that the sulphuret of sodium is a dead loss to the manufacturer, and moreover diminishes the market value of the rest of his produce, the question of hot or cold water, with or without proper pulverization of the ball-soda, is in reality a very important affair.

By the afore-recited analysis, it appears that, out of 22·91 parts of soda, 2·11 were combined with sulphuretted hydrogen; this is at the rate of more than 9 per cent., and would form a handsome addition to the usual profits of the manufacturer. One of the great drawbacks upon the manufacture of soda is the difficulty of disposing of the insoluble residue. This contains more than half its weight of sulphuret of calcium, a substance which, in the wet state, is rapidly decomposed by the carbonic acid of the air with the evolution of sulphuretted hydrogen gas, and, if moderately dry, is almost certain to take fire by contact with the atmosphere, and thus taint the surrounding neighbourhood with its sulphurous emanations. It is extremely likely that this refuse product would answer the purpose of lime for all agricultural uses, and also furnish sulphur to such crops as require this element,—plants of the natural order, *cruciferæ*, for example. Gas-lime is, in great measure, a perfectly analogous compound; and this is largely used in some of our inland counties, and found to be an extremely beneficial application. The refuse of soda-works has not, however, assumed a similarly favorable character amongst farmers; and it is now a real and growing nuisance to the manufacturer of soda.

Perhaps, after all, it would be better to think of devising a remedy for preventing the formation of this residuum, than seek an outlet for its consumption. With this view, we venture to lay the following process before our readers, as embracing within itself what may be termed the perfection of soda-making. How far, on a large scale, the difficulties might increase beyond the advantages, our experience will not enable us to judge; but, in a moderate way, the whole of the operations have been consecutively tried and found satisfactory. The key to the ultimate decomposition turns upon a circumstance in chemistry which is, for the most part, but little known, and that is, the ease with which the hydrosulphates of the alkalies, when slightly moistened, are converted into carbonates by the action of carbonic acid. If much water be present, the decomposition goes on languidly, and is never perfect; if too little water, the decomposition is speedily arrested by the formation of a crust of alkaline carbonate. It is the middle state, between these two conditions, which must be aimed at, and which we will now proceed to describe in a condensed account of the proposed method:—With a precisely similar form of apparatus to that now in use for preparing sulphate of soda, and condensing muriatic acid, but with some little additional care, a given weight of common salt might be converted into sulphate of soda, and the whole of its muriatic acid condensed, which, of course, would be an exact equivalent to the soda present in the sulphate of soda; that is to say, 60 parts of chloride of sodium, and 49 parts of pure hydrated sulphuric acid, would produce 72 parts of dry sulphate of soda, and 37 parts of anhydrous muriatic acid. These relative proportions must be borne in mind to facilitate the comprehension of the ultimate process. Having placed the muriatic acid on one side for the present, we proceed to convert the sulphate of soda into sulphuret of sodium, by mixing it with its own weight of coarsely-powdered coal or coke, and exposing the mixture to a red heat in a proper furnace for an hour or two. At this temperature the carbon of the coal unites with the oxygen of the sulphate of soda, and flies off as carbonic oxide-gas, leaving the sulphur and sodium combined together as sulphuret of sodium, with the excess of small coal or coke employed. As soon as this mixture is sufficiently cool, it should be broken or pounded into a rough powder, which must now be moistened with water to the consistence of damp sand, or until a handful, tightly squeezed in the hand, adheres together as a ball or lump. When this is the case, the whole should be placed in a vessel, or set of vessels, similar to those used for the purification of coal-gas by means of slaked lime. It is best to have four of these vessels,—three of which are to be continually in action. The moistened sulphuret of sodium, or hydrosulphate of soda, being duly arranged, a stream of carbonic acid is made to traverse the three vessels in action, by which the hydrosulphate of soda is converted into carbonate of soda, and the hydrosulphuric acid, or sulphuretted hydrogen, being expelled in a pure state, may readily be burnt at a jet in a common sulphuric acid chamber, with the usual dose of nitrate of soda for its acidification. Thus the quantity of sulphuric acid originally employed to decompose the salt would be constantly regenerated and used over again. The requisite carbonic acid would also be easily procured by acting upon chalk with the muriatic acid condensed in the first instance. Some fear might seem to be justified by the possibility of the carbonic acid passing off with the sulphuretted hydrogen; but, under common care, guided by experience, this could never occur. So long as any considerable quantity of hydrosulphate of soda remained in the second and third vessels, no carbonic acid could pass through them; and, as soon as No. 1 was discovered to be saturated, this might be thrown out of action, and the fourth vessel employed. Meanwhile, No. 1 might be emptied, and refilled with fresh material to follow on after No. 4, when the second vessel was saturated; and thus on continually.

In commencing this description we assumed at first 60 parts of common salt and 49 of hydrated sulphuric acid, which would give 72 of sulphate of soda, and 37 of muriatic acid. Now these 72 of sulphate of soda would form 49 of hydrosulphate of soda; whilst 37 of muriatic acid, by acting upon chalk, would furnish exactly sufficient carbonic acid to convert the 49 of hydrosulphate of soda into 54 of carbonate of soda, and 17 of sulphuretted hydrogen. But this sulphuretted hydrogen, when carefully consumed, would regenerate 49 parts of sulphuric acid, to be again used in decomposing 60 parts of common salt, and so on in endless rotation. The only resulting products would, therefore, be carbonate of soda and muriate of lime; the sulphuric acid merely performing the part of a vehicle for effecting the decomposition. As regards the economy of this process, it seems in no way doubtful, and, viewed in a practical light, there is no insurmountable or even probable difficulty in the way of its immediate and successful adoption: necessarily there would arise some loss from waste, and commercial impurities; but the scope for speculative industry is very large, and all risk of failure may be reduced within reasonable limits by beginning upon a very small scale at first, and extending the manufacture in proportion to the success of the enterprise. The huge mountains of sulphuret of calcium which arise under the present system, and contaminate the air with their pestiferous exhalations, proclaim too obviously that a change is needed; and some idea of the enormous mass of matter thus daily accumulating, may be gathered from the fact, that one soda-maker alone admitted to us that his average production of this residue was at the rate of 400 tons per week, or 20,800 tons per annum.

THE MANUFACTURE OF SOAP.

This branch of industry is so closely dependent upon the above subject of our remarks that we need but trace a portion of its products through the market, to find ourselves in the midst of a soap works. It will be remembered that, in speaking of the action of the carbonating furnace, we had occasion to explain how the carbonate of soda, contained in the roasted product, was extracted by lixiviation and crystallization, and the mother-liquor, or uncrystallizable portion, being subsequently evaporated to dryness, and sold under the name of soda-ash, in common with the direct product of the carbonating furnace. This soda-ash is the substance employed in the manufacture of soap, and varies in the amount of soda it contains to the extent of from 30 to 50 per cent., according to the mode of its formation. A small quantity of this soda is occasionally in the caustic state; but the great bulk is combined with carbonic acid, as carbonate of soda and variable proportions of chloride of sodium and sulphate of soda exist with it in the soda-ash. The fabrication of soap is under the surveillance of the Excise, and consequently there is little or no scope for improvement,—an assertion well supported by the notorious fact that no alteration has taken place in it since the reign of Queen Anne. Yet, looking upon the innumerable changes and metamorphoses which the fats and oils are capable of undergoing through the agency of chemistry, there is no subject which offers a fairer field for the labors of inventive genius than this very manufacture. The elements united together in the class of animal and vegetable oils or fats are not numerous, but seemingly fitted for displaying an endless mutability; and no doubt the day will come, when, from perhaps the cheapest and most worthless of these substances, we shall be able to form every other variety; or, even from wood and coal, extract substances of this kind to rival and supersede tallow, wax, or spermaceti. At present, however, the principal manufacture interested in the working out of such questions lies under the inquisitorial power of our great fiscal harpy. Improvement, under such an influence, loses its reward; for concealment is impossible, not only for the period required to seal a patent, but even for a day or an hour. The Excise officer is omnipotent in a soap works, for he carries the master key of every lock on the premises—all must open when he knocks—all must explain when he questions. In spite, therefore, of the thousands of interesting discoveries which have been made within the last twenty years in departments of the arts closely allied to soap-making, this manufacture has stood still for more than two hundred years, and presents the most remarkable proofs of the unwholesome and impolitic nature of Excise interference. Under such circumstances, we feel almost compelled to depart from our ordinary course of offering a few remarks in the direction of improvement. Hints of this kind are to the soapmaker like the water bubbling in the cup of Tantalus. He may see but cannot enjoy the proffered boon, for he is tied down by regulations, presumed to have been necessary for the social status of this kingdom at the time of Queen Anne. Our remarks upon the soap manufacture will, consequently, bear no proportion whatever to the importance of the subject, nor to the position which it would assume to-morrow if relieved from Excise restrictions: the incubus which has so long restrained the wing of invention would laugh at our efforts to raise the victim of his oppression.

In this department of industry improvement has therefore, of necessity, a foreign origin, and hence we regard it as a mere matter of course that the Exhibition prize medal for soap should have passed into the hands of an American. Mr. John Ransom St. John, of New York—for the soap made under whose process a prize medal has been most justly awarded—has, we see, secured his process in this country by letters-patent: yet it will not surprise us in the least to find that Mr. St. John is prevented by the Excise from following out his invention here. A circumstance exactly parallel to this assumption occurred a few years ago to another foreigner, Dr. Normandy, who had taken out a patent for improvements in soap making, but was ruinously interfered with and ultimately stopped by the Excise. In wishing Mr. St. John, therefore, all the success his extremely ingenious invention merits, we warn him that he may yet fall beneath the crushing influence of the Broad Street authorities.

The first step in the production of soap consists in obtaining a solution of soda, or what is termed caustic ley. For this purpose a given quantity of the soda-ash previously spoken of, is mixed with an amount of recently slaked lime proportioned to the previously ascertained strength of the soda-ash; with these a certain bulk of sand is generally mixed, for the purpose of facilitating the subsequent process of filtration. The entire mixture is now placed, layer by layer, in a tank, similar to that described for lixiviating the ball-soda in soda works. The layers of mixture are separated by layers of rush matting from each other, and a plug being driven into the lower orifice of the tank, this latter is filled full of water and allowed to stand for twelve or eighteen hours. The plug being then withdrawn, the saturated solution of caustic soda flows down into a reservoir, placed beneath; after which, the plug is again replaced—more water applied—and this operation is repeated five or six times; the various liquors, thus obtained, being conveyed into separate reservoirs, and distinguished from each other by the names first running, second running, and so on,—the last being, of course, the weakest. When weak soda-ash is employed, little or no common salt need be added to the mixture in the lime vat; but when soda-ash of great strength is used, it is necessary to add a considerable quantity of common salt to it, for a purpose which will shortly be explained. Having in this way procured a series of caustic leys, of different degrees of strength, the weakest is pumped up into a boiler, or copper, as it is called, though generally made of cast-iron. To this ley a quantity of tallow is added, and the whole boiled for some time, or until, upon testing it, the ley is found to have lost its caustic property. The whole is now allowed to cool and remain at rest until the ley, now deprived of its alkali, settles to the bottom of the copper; from whence it is pumped out by a kind of force-pump, as the Excise regulations do not permit it to be withdrawn or run off, as it is in other countries, from the bottom of the boiler. This fluid is denominated spent ley, and contains a portion of glycerine, derived from the fat or tallow, together with the sulphate and muriate of soda, of the soda-ash, and an additional quantity of muriate of soda added by the soap-maker. The presence of this muriate of soda is indispensable, for otherwise the tallow and ley would unite into a uniform emulsion, from which it would be impossible afterwards to separate the spent ley; but as soap is altogether insoluble in a solution of common salt, the partially saponified compound is thus brought to float on the surface, and permit of the spent ley precipitating to the bottom, from whence, as we have seen, it is pumped away and lost, being of no value.

This constitutes what is called an operation; and after continuing to repeat these operations three or four times, with leys of gradually increasing strength, a period arrives at which the grease is said to be "killed," or, in other words, the tallow is saponified, or combined with its full equivalent of soda. This point is well known to the workmen by the consistence of the compound, when a little of it is squeezed between the finger and thumb and allowed to cool; if finished, it readily separates from the skin as a hard cake, and, moreover, has no longer the taste peculiar to grease; if, on the contrary, any tallow remain unsaponified, this oozes out by the pressure, and becomes perceptible both to the sight and taste. A more certain mode, however, is to decompose a portion of the suspected soap by means of an acid, and ascertain whether the resulting grease is wholly soluble in boiling spirits of wine, for, if not, the saponification has been imperfect. Presuming, however, that a perfect result has been secured, the soap has now to be brought into a marketable condition, and, for this purpose, it is fused with a quantity of weak ley or water. So soon as combination has taken place, a quantity of very strong ley is added, until an incipient separation begins to shew itself. The heat is now increased, and the boiling continued for a considerable time,—the mass being prevented from boiling out of the vessel by workmen, armed with shovels, who dash the soap to and fro, so as to break the froth upon the surface, and favor evaporation. At first the soap is divided into an innumerable number of small globules, each separate and distinct from its fellow; but, as the boiling goes on, those gradually run together into larger and larger globules, till at last the soap is seen to assume a pasty consistence, and to unite in one uniform mass, through which the steam from below slowly forces its way in a series of bursts or little explosions. The process is now finished, and all that remains to be done is to shut down the lid of the copper, having previously extinguished the fire. In from one to two or three days, according to the nature and quantity of the soap in question, the lid is again raised, and the semi-fluid soap ladled from the precipitated ley by means of ladles; the product being thrown into a wooden or iron frame, of specific dimensions, where its weight is estimated by measurement, and the duty charged upon it. In making common yellow or resin soap, the resin is usually added after the saponification of the tallow, in the proportion of one-third or one-fourth of the tallow employed. The subsequent operations are much about the same as those above described; but, in addition, just before closing the lid of the copper, a quantity of water or weak ley is sprinkled over the melted soap, which carries down with it the mechanical impurities of the resin; and these constitute a dark layer of soap, resting upon the ley, which is not poured into the frame with the rest, but is placed apart under the name "niger," and brings a less price. Good curd or white soap should contain, of

Grease	61 parts.
Soda	6·2
Water	32·8
	100·

or consist of

Grease acid	1 atom	= 315
Soda	1 atom	= 32
Water	17 atoms	= 153

Resin soap has a more variable composition, but when not adulterated with water should contain about as follows:—

Grease and resin	60
Soda	6
Water	34
	100

The manufacture of soft soap differs greatly from that of hard soap; as, in this case, nothing is separated from the mixture in the boiler; and the alkali employed is potash, and not soda. The mode of obtaining a caustic ley of potash is, however, exactly the same as with soda, except that the weak leys are used in place of water for a subsequent operation, and not pumped up into the boiler. The materials employed as fats, are mixtures of the vegetable and animal oils, as rape, and the fish-oil called "Southern." For the best kinds of soft soap, a little tallow is added to these, which produces a peculiar kind of mottling or crystallization in the soap that confers additional value upon it. These oils or fats are merely boiled with the strong caustic potash-ley until thorough combination has taken place, and so much of the water of the ley is evaporated, that, when a portion of the soap is poured upon a cold slab, and allowed to rest for a few minutes, it assumes the consistence of weak butter. As soon as this happens, the whole is run out into little casks, where it cools; and is thus sent into the market. Of course no atomic arrangement can be traced in so variable a compound; and hence its analysis presents no point of interest. The employment of soft soap is daily becoming more and more limited. Soft soap usually contains as under,—

Fatty oils	43
Potash	10
Water	47
	100

but its composition differs greatly.

MUSICAL INSTRUMENTS.

FREE-REED INSTRUMENTS.

A CLASS of keyed musical instruments has lately come into extensive use, combining, in a remarkable degree, the advantages of volume of tone, compass, the power of *sostenuto,* and expression, and having, in addition, the useful qualifications of simplicity of construction and smallness of size. Instruments of this class exist in different forms, and under various names; but, as they are all modifications of the same principle, we have classed them together under the above title. The tones are produced in each by what is called the free-reed, an apparatus, the construction of which will be understood from the following description.

In the ordinary reed-pipe of an organ (a description of which is given at page 108, *ante*) the sound is produced by the vibration of a thin tongue of metal, allowed to beat upon the flattened side of a tube, and so alternately to cover and uncover a slit or opening, through which the air passes into the pipe above. Now, let us suppose that the brass tongue (which, in the above case, must of course be large enough to cover the opening entirely, and to bear on its margin) be made a little smaller, so as not to cover the opening, but just to enter within it without touching. The consequence will be, that when the reed is set in vibration, it will no longer *beat* against the plate, as in the ordinary organ reed, but will oscillate *freely*, entering the opening and leaving it again at each vibration. It is obvious that, since the tongue is made to close the opening as nearly as possible, it will check, in every vibration, the current of air passing through, in the same manner as the beating-reed; and the effect will therefore be, as in that case, a series of pulsations in the air, producing a musical tone.

This disposition of reed is called a *free-reed*, and it has several advantages over the beating one, which have led to its adoption in the class of instruments we are now describing.

In the first place its tone is of a more agreeable quality, more smooth and mellow, and free from the tendency to become harsh and snarling, which often exists in the beating-reed.

Secondly, it requires no pipe, which, in the beating-reed, is always necessary to modify the tone; without this addition, indeed, the ordinary organ reed-stops would be unendurable. The importance of this advantage, as regards simplicity, cheapness, and compactness, must be self-evident.

Thirdly, it is less liable to get out of order;—the beating of the ordinary reed is constantly tending to produce derangement, and to throw it out of tune; the free-reed, encountering no obstacle in its vibration, is much less liable to be disturbed.

Fourthly, it gives an entirely new property, which the ordinary organ does not possess, namely, the power of *expression*. The beating-reed gives but the one grade of tone it is voiced to, without variation, and will only speak properly under the pressure of wind it is originally constructed for; but the free-reed has the valuable peculiarity, that, by varying the pressure of the wind, the power of the tone may be varied at pleasure, without altering the pitch. The reason of this is found in the well-known fact, that the vibrations of an elastic body will be isochronous, no matter what the extent of the oscillation may be. The effect of a more powerful wind is to increase the arc of vibration, and the greater impetus of the passing air gives a more powerful tone; but since the vibrations are performed in the same time, the pitch of the note remains uniform. By simple contrivances, therefore, for varying the pressure of the wind, the free-reed may be made to give any gradation of *piano* and *forte*, and to produce any *crescendo* and *diminuendo* effects that may be desired.

The free-reed is very ancient, having been used in China from time immemorial; its modern revival in Europe appears to be due to the efforts made to give to the organ the power of expression. About 1810, a M. Grénié constructed two instruments on this principle, one of which was sent to the Conservatoire, the other to the convent of the Sacré-Cœur, at Paris. In 1827, three stops, on the free-reed or expressive principle, were introduced into the organ at Beauvais Cathedral by a workman of M. Grénié's, named Cosyn, and who was again employed, in 1829, by M. Sebastian Erard, to execute a stop of a similar kind in an organ built by him for the Tuileries. M. Erard varied the application in a novel manner, by making the expression depend on the depth of the touch. This organ was destroyed in the revolution of July, but the free-reed stop was saved, and is still in the possession of M. Erard. The new idea embodied in it, however, has not been further carried into practice.

These attempts excited but little notice, and the use of the free-reed would probably not have been much extended, had not the principle been applied in a more popular form. About 1827, a little instrument was made in Germany,* consisting of a few simple free-reeds, fixed in a thin metal plate, and blown directly with the mouth; they were so tuned as to sound a chord when blown together, or a set of trumpet notes separately. Then came an extension, by putting several chords on the same plate, either of which could be taken at pleasure, or the notes picked out separately, so as to form a connected melody. The instrument thus improved was made in England by Messrs. Wheatstone, who called it the *Æolina*, and published, in 1829, a book of instructions for its use.*

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* In 1829, a M. Pinsonnat patented, in France, what he called a *typotone*, viz., a single free-reed set in a plate of metal, or mother-o'-pearl, and used as a substitute for the tuning-fork or pitch-pipe. This is claimed by the French as the original of the portable free-reed instruments; but there is evidence that the German contrivance alluded to in the text was invented, and imported from Leipsic into England, by Messrs. Wheatstone, at an earlier date.

By successive augmentations, however, the instrument soon became too large for the mouth, and the next step was to attach to it a small hand-bellows, and a set of keys, opening valves for the various notes: this formed the *accordion*, an instrument which, though exceedingly imperfect, has been the most popular of all the applications of the principle. In its smallest and simplest forms it has been made for a few pence, as a plaything for children, while in its most expensive shape it has aspired to the execution of music of no mean character. According to the usual construction, the accordion consists of a pair of rectangular single bellows, one board of which is held in each hand; so that by separating the hands the bellows are extended, and caused to draw in air; and by approaching them together, the air is forced out again. The board held in the right hand contains the reeds, with their finger-keys and valves; which are so arranged that each key covers two reeds and corresponds to two notes,—one being sounded in expanding, and the other in compressing the bellows. For example, when a certain key is opened and the bellows expanded, they will draw in air through the reed sounding C; but when compressed, they will force out the air through the reed D. Similarly, the next note will give E, by expanding, and F, by compressing, and so on; the object being to increase the compass, without augmenting the number of keys. There are also one or two chord keys, by opening which, the instrument will sound certain chords, giving a rude kind of accompaniment to the melody; and there is also a wind-valve, managed by the left-hand, by the aid of which the bellows may draw in or expel air when required, without causing the reeds to sound. It may be gathered, however, from this description, that the accordion is a most defective instrument, little better indeed than a toy; it will play in only the key it is constructed for, and even in this its capabilities are very limited; and though its tones are pleasing, its effects soon become monotonous and disagreeable to the educated ear.

A far more successful instrument of this kind is the *concertina*, the invention of Messrs. Wheatstone. Shortly after the introduction of the Æolina by this firm, as noticed above, they effected a considerable improvement upon it, by enclosing the reeds and plate in a small box, and adding valves to open any of the notes at pleasure: this was called the symphonion; the wind was supplied to the interior of the box by the mouth, and the valves were acted upon by studs projecting from the two sides, conveniently for the fingers of the right and left hand. The substitution of bellows for the action of the mouth, and certain other improvements consequent thereupon, transformed this instrument into the *concertina.* It consists, as now made, of a hand-bellows, with reeds and keys, something like the accordion in its general principle, but differing essentially from that instrument in the arrangement of its details. The bellows are of an octagonal shape, and the reeds and keys are contained in both boards, so as to be played on by the fingers of both hands. The keys consist of small cylindrical studs, projecting from the middle of the bellows boards, and are ingeniously arranged for facility of performance. The bellows boards are held by straps passing round the back of the hands, so that the fingers are left at liberty to act on the keys without impediment. All the reeds are in duplicate, so that, whether the bellows be expanded or compressed, the same note is sounded, and each note has a separate key. Any degree of *piano* or *forte* may be produced by using more or less force with the bellows, and the instrument thus gives great facility for expression. The concertina, though merely a hand instrument, has a compass of 3 or 3½ octaves, with a complete chromatic scale; so that melodies can be played in any key, and can be accompanied, to a certain extent (limited only by convenience of fingering) with harmonies also. The kind most used is a treble instrument, corresponding in compass with a violin; but varieties are also made to correspond with the viola and the violoncello. It serves therefore not only for music of its own, but may also be used, in case of need, to play solos, or obligatos, written for other instruments of a different kind,—the tone and expression of which it will often imitate with tolerable effect.

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* A description of this instrument was published, in 1829, in the "Harmonicon," a monthly periodical devoted to musical subjects.

The free-reed has, however, received a more extended application. In the attempt to improve the accordion, by enlarging and completing its scale, it became so unwieldy that it could no longer be held conveniently in the hands, or played upon with ease; and, as a natural remedy for this difficulty, the plan was adopted of applying a regular clavier, and furnishing the wind by separate bellows as in an organ. The instrument thus became, in fact, transformed into an organ having a free-reed stop without pipes; a return very nearly to the original application of the free-reed. The instrument was early made, in this form, in England, by Mr. Green, of

Soho-square, and called the seraphine; it had a compass of several octaves, and from its cheapness and small size soon became popular. It was extensively manufactured and considerably improved in France, and in 1842, M. Martin, of Paris, introduced an improvement of considerable importance, with the view of remedying a defect, previously existing to some extent, namely, the want of promptness in articulation. It consisted of a small hammer, connected with the key, which gave a gentle blow to the reed at the moment of opening the valve; the effect of this was to make the note speak with a rapidity and precision very remarkable, and gave the tone a peculiarly brilliant and agreeable quality.*

Many varieties of the free-reed clavier instrument have been made, both in England and on the continent, under various names; such as the seraphine, aolophon, physharmonica, harmonium, melodium, symphonium, poikilorgue, orgue expressif, aolomusicon, &c.; of which the Exhibition contained several examples; but, as they are all essentially the same instrument, it will be sufficient to give a description of one of the most modern and best known construction. The clavier has a compass of 5 octaves,—the lowest note being 8-feet C, corresponding with the fourth open string of the violoncello. It has four stops, divided into halves, and acted on by eight draw-stops, placed immediately over the clavier, so as to be within convenient reach of the hands. They are named as follows in the instrument we inspected, but different terms are used by different makers:—

	Bass.	*Treble.*	
1.	Cor Anglais	Flute (Percussion)	8 feet.
2.	Bourdon	Clarinette	16 feet.
3.	Clairon	Fifre	4 feet.
4.	Basson	Hautbois	8 feet.

These are all formed with the free-reed; the two 8-feet stops are of different qualities, and one of them is acted on by the percussion movement already described. The mechanical parts of the instrument are very simple. The keys open valves, by which the wind from the bellows is allowed to act on the reeds, and the draw-stops open or close the communications with a whole row of reeds together. The bellows are of the ordinary double construction, with a reservoir, and two feeders worked by the feet of the performer. In the ordinary state of the instrument the wind is supplied to the reeds from the reservoir of the bellows, at constant pressure, as in an organ, and the tone is then of uniform strength; but there is a simple contrivance by which the power of expression is given. By drawing a stop, marked "expression," the wind communication to the reeds is cut off from the reservoir of the bellows, and opened to the feeders; by pressing the foot down, therefore, with different degrees of force, piano or forte, crescendo or diminuendo, may be obtained at pleasure; the management of this requires, however, a little practice, as the two feeders must be used alternately, to give the opportunity for replenishing them with air. In addition to the stops above named, there are others of a mechanical nature; one called the "grand jeu," which brings on the "full organ" at once, and another marked "forte," which opens a sliding shutter to increase the volume of sound, something on the principle of the swell of an organ. The "sourdine" and "celeste" are mechanical contrivances, by which the tone of certain of the stops is modified, to produce variety. The quality of tone of all the stops depends, in some degree, on their positions, and on the arrangement of the wood cases in which they are enclosed, and which act, in some measure, as sound-boards. The instrument is of small size, considering its power and capabilities; it is about 4 feet wide by 2 feet deep, and 3 feet high. The price is from 35 to 50 guineas. An instrument of this kind, constructed with two claviers and pedals, would be by far the best substitute for the organ, in chambers and other small rooms. The so-called chamber organs, consisting of three or four soft stops on one row of keys, besides being expensive, possess very few of the qualifications of the instrument whose name they bear.

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* It is right to state that, in a patent taken out in France, in 1834, and subsequently in England, in 1839, M. Pape describes springs struck by a hammer, the vibration being afterwards prolonged by wind, "according to the manner of a seraphine." The difference between this and M. Martin's contrivance appears merely to be, that in the former the principal effect is due to the blow, while in the latter the percussion is subsidiary.

Messrs. Luff & Son, exhibit a "harmonium," nearly similar to that above described, but with the addition of a mechanical apparatus for playing it. This is on the principle of the *piano-mécanique* of M. Debain (described at page 43, *ante*), the tune being formed by a series of pins set in a tablet. This tablet is drawn through a frame, in which project wedge-shaped ends of levers; and these are depressed by the pins as they pass over them. For the piano-forte, the levers are connected with the hammers; but, for the organ or harmonium, they act on a series of rods, pressing immediately upon the keys of the clavier. This apparatus possesses therefore a great advantage over the barrel system, inasmuch as it is entirely separate and distinct from the instrument, and may be applied, for a few guineas, to any existing finger organ or harmonium, without in the least interfering with its construction. It may be put in action in a few minutes, or removed in an equally short time, leaving the clavier perfectly free for playing upon with the fingers. There is also a novel contrivance in this apparatus peculiarly useful for accompanying chants or psalm tunes in churches. In the ordinary arrangement of the machine for playing pieces in strict time, the tablet is drawn through the frame by a rack and pinion,—the latter being turned by a winch at a uniform rate; but it almost always happens, in the case of psalmody and chanting, particularly the latter, that the time must be relaxed, occasionally, to suit the singers. To enable the player to do this, an apparatus is added, by which tablets, containing music of this description, are drawn through, not by a rotatory but by a reciprocating motion, so that each thrust of a lever, backwards or forwards, brings on one note of the tune. It is obvious that, by this arrangement, the duration of each note may be prolonged or shortened at the pleasure of the player, and therefore may be accommodated to the singing with perfect ease.

A small kind of harmonium is made, which can be placed immediately in front of the key-board of a piano-forte, and played in conjunction with it. We have already noticed an arrangement of this description at page 36, *ante.*

A still smaller instrument, of the same kind, is exhibited by Messrs. Wheatstone, called the "folding harmonium." It has a compass of 5 octaves, and when expanded for use is 41 inches long, 10 inches deep, and 25 inches high; but by an ingenious arrangement it is made to fold in the middle of the clavier, and also underneath, by which its dimensions are reduced to 21 inches long, and 10½ inches high, a size but little exceeding that of an ordinary writing desk. Another folding harmonium, called an *orgue de voyage,* is exhibited in the French department by M. Muller, but this merely folds in height, retaining the full length of the clavier.

Mr. J. Storer exhibits a free-reed instrument, which he calls the "œolomusicon," the peculiarity of which is, that the vibrating tongue and its plate are formed from one and the same piece of metal.

Mr. R. Snell exhibits a "bichromatic seraphine," intended to give perfect harmony in any key. The clavier is exactly the same as usual, but the instrument contains a double chromatic scale, *i.e.,* 24 notes in each octave; from which, by means of pedals, the proper sounds are selected and adapted to the key-board, rendering all the common chords perfect in each particular key without any trouble to the player. There are 12 pedals, one corresponding to every semitone; and, in order to play the instrument, nothing more is required than to put down the pedal corresponding with the key note before commencing any piece. The principle is stated to be also applicable to the organ.

The free-reed, with a pipe attached, is now frequently used in organs by foreign builders; it gives a smoother kind of tone than the beating-reed. The addition of a pipe of proper proportions causes it to speak more promptly, and improves the tone. The French and German organs in the Exhibition contained stops on this plan. It has not yet been adopted by English manufacturers.

THE HARP.

The harp, if it has few claims to importance on musical grounds, has, at least, the distinction of a high antiquity. Wherever antiquarian research has penetrated, this instrument appears as one of the most prominent musical contrivances of ancient times. And this is but natural, if we consider its extreme simplicity. It is but a set of strings, stretched on a frame; and, as soon as the discovery was made, that cords, subject to tension, would produce agreeable sounds, the invention of the harp, or something equivalent to it, must have followed as a matter of course. Warlike savages have been known to make a sort of wild music by the twanging of their bow-strings; and the ancient poets fancifully ascribe the instrument of Apollo to the hint given him by the sound of his sister Diana's bow.*

The records of Holy Writ, the antiquities of Egypt and of Assyria, and the ancient literature of Greece, may be cited in proof of the early date at which the harp existed.

There appear to be two stringed instruments mentioned in the Bible, as in use among the Jews, viz.:—

1. The כִּנּוֹר; this is the earliest instrument mentioned, and its invention is ascribed (Gen. iv., 21.) to Jubal, the seventh in descent from Adam. David used it in expressing his pious feelings, as we find from several Psalms. Josephus, in his Antiquities (book x., ch. 12., sec. 3.), describes it as having ten strings, and as being played upon by a *plectrum*; but this does not agree with 1 Sam. xvi., 23, where David is said to have played on it with his hand.

2. The נֵבֶל, a word also signifying a wine bottle, from

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* The Greek word ψαλμος, which now bears so elevated a musical signification, literally means the sound of a bow-string.

which the musical instrument probably took its name. The ancient wine jugs were usually in the form of a sugar loaf, which this kind of harp resembled. Jerome describes it as being of a triangular shape, like the Greek Δ inverted. Josephus mentions this instrument as being played upon by the hand, and having twelve strings; but in Ps. xxxiii., 2, the same word is used in the expression, "an instrument of ten strings."

It would seem that these instruments were more portable than our harps, as they were played in a procession; but that they embodied the same essential principles there can be no doubt whatever.

The Egyptians, who, there is reason to believe, possessed musical instruments superior to those of the nations of antiquity that followed them, used a kind of harp which must have been but little inferior, either in elegance of form, skill in construction, or musical powers (if we except the pedals) to the harp of the present day. In an ancient sepulchre, among the ruins of Thebes, Bruce, the traveller, discovered a drawing of the harp, which he considered must have been executed between 1600 and 1500 years before the christian era. The harp was represented as about 6 feet high, supporting itself in equilibrio on its foot or base, and needing only the player's guidance to keep it steady. It had thirteen strings, and a sounding-board, as nearly as possible corresponding in shape and position with that of modern date. It appears also to have been finished with much taste and elegance. The letter of Bruce to Dr. Burney, containing an account of this instrument, concludes with the following striking reflection: "This harp overturns all the accounts of the earliest state of ancient music and instruments in Egypt; and it is altogether, in its form, ornaments, and compass, an incontestible proof—stronger than a thousand Greek quotations—that geometry, drawing, mechanics, and music, were at the greatest perfection when the harp was made; and that what we think, in Egypt, was the invention of arts, was only the beginning of the era of their restoration." This account of Bruce was at first received with some suspicion; but later travellers have confirmed his statements.*

The sculptures discovered by Dr. Layard, in the ruins of Nineveh, also contain representations of a musical instrument, which cannot be better described than as a portable harp. It occurs in three different places in the series of slabs now deposited in the *Nimrúd* room at the British Museum. Two of these represent processions, in which the king, returning from hunting, is met by five figures,—the two last being musicians, standing side by side, and playing upon the instrument referred to. In the third slab, representing the Assyrian camp, a group of warriors, carrying the heads of the slain, are rejoicing in company with two musicians, also with harps in their hands.

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* The famous Egyptian pillar, brought to Rome by Augustus, and now known by the name of *la guglia rotta*, bespeaks a still higher degree of improvement in stringed instruments, namely, the addition of the *finger-board.*

The instrument is precisely alike in all the representations. It has a frame, consisting of a long and a short piece, attached together at right angles in the form of an L,—the strings being stretched diagonally from one to the other. The number of strings is, in every case, nine, and the whole instrument would appear to be 2½ or 3 feet long. It is held under the arm of the player, with the long side of the frame horizontal, and the short piece (at the end of which a hand is sculptured) pointing upwards in front. The right hand of the musician is elevated, and holds a small rod or *plectrum*, with which, no doubt, the instrument was played; the left hand is shewn extended flat over the strings, but for what purpose is difficult to decide; it may be either for damping the vibration, or for stopping the length of the string, or for playing with the hand alone, alternately with the plectrum. The instruments are partly hidden, and from this cause, as well as from the general imperfection of the drawing, the representations are somewhat obscure.

In the literature of ancient Greece, we find mention of three instruments of the harp kind, but probably differing little from each other. The φορμιγξ (*phorminx*) was the oldest stringed instrument of the Greek bards, and is often mentioned by Homer, especially as the instrument of Apollo (Iliad I., 603, and 24, 63). It was frequently adorned with gold, ivory, precious stones, and carved work. The κιθάρα (*cithara*, whence our word guitar) was a kind of lyre, or harp of a triangular shape, with seven strings originally, but afterwards increased to nine or eleven. This is also often mentioned by Homer, but with a trifling variation (κιθάρις) in the orthography. The λυρα (lyra) is said to have been invented by Hermes, but is not mentioned in Homer. It had seven strings, like the *cithara;* but the body of the instrument was larger, and the tone more full and rich; and on this account it was considered the most manly of all stringed instruments. The *cithara* was held on the knee; but the *lyra* was too large for this position, and is therefore supposed to have stood on the ground, like the harps of modern times.

The harp has, however, an antiquity in our own islands,—the Welsh and Irish bards being celebrated from time immemorial for their performances on this instrument. Before the invasion of Julius Cæsar the Britons had music; and the bards, like the Levites among the Hebrews, were the sacred musicians. We have the authority of the venerable Bede for the practice of social and domestic singing to the harp in the Saxon language, in this island, at the beginning of the eighth century.

The Celtic harpers are mentioned by Diodorus Siculus, who says they played on instruments like lyres; *οργάνων ταῖς λυραις ὁμοίων*. Also Fortunatus, lib. vii., carm. 8.

> "Romanusque lyra, plaudat tibi barbarus harpa,
> Græcus Achilliacha, crotta Britanna canat."

Crotta is *crwth* Latinized,—this being an original British or Welsh instrument, somewhat distinguished from the *telyn*, or harp peculiar to the bards. All our historians relate the romantic story of Alfred reconnoitring the Danish camp in the disguise of a harper; and there is good reason to believe that the harp was a favorite instrument among our Saxon ancestors. An ancient Irish harp, which had twenty-eight strings, and was thirty-two inches high, is reported to have belonged to a certain king, Brian Boromn, who was killed in battle in the year 1014. It was presented to the Pope by his son, was afterwards in the hands of King Henry VIII., and is now in the library of Trinity College, Dublin. The modern Irish harp is strung with strings of brass wire, nine in number, and is calculated only for a melody of an imperfect description. Whether the Welsh had their harp from Ireland, or the Irish theirs from Wales, is still a dispute between the champions of St. David and St. Patrick.

The harp in its primitive form consisted simply of a set of strings, extended on a frame,—one end of each string being fixed, and the other wrapped round a pin, for the purpose of tightening to any required tension. The frame was formed of a triangular shape, so as to admit strings sounding different notes, according to their length. It seems, however, to have been very early discovered, that the mere twang of a string was insufficient to produce any considerable tone without the aid of some resonant body; and hence arose the addition of the *sound-board*, a thin elastic substance, so placed as to vibrate under the impulse given to the string, and thus to prolong and strengthen its tone. The sounding contrivance seems to be very ancient; and indeed one account of the origin of the lyre is, that Mercury formed it by fastening strings to the shell of a tortoise, whence it was called *testudo,* "the sounding shell." In the lyre tribe of instruments, of which the guitar and the violin are modern representatives, this idea has been followed out by the adaptation of sounding-boards underneath and parallel to the strings;—a principle also adopted in the piano-forte, and the most favorable one for effect, inasmuch as the reverberating body may be given a considerable extent of surface, and placed in the best acoustical position. In the harp, however, the adaptation of this arrangement has been impracticable, from the necessity of using the hands on both sides of the series of strings; and hence the sounding-board has been limited to a very small surface, formed by extending and flattening that side of the triangular frame to which the lower ends of the strings are attached. Harps with this addition appear among the oldest representations of the instrument that have been found.

The arrangement and tuning of the strings in the ancient harps, no doubt corresponded to the systems of melody predominant in those times;—since the introduction of our present musical scale, they have invariably been arranged diatonically,—*i. e.,* with the diatonic scale of seven notes repeated in different octaves. Now it is evident, at first sight, that such an arrangement has the disadvantage of being limited to the capability of playing in one key only,—namely, the key it is tuned to; there being no chromatic notes to provide for either what are called accidentals, or for modulation into any other scale. The efforts to remedy this defect have given rise to the only improvements and alterations of any importance which have been made in the powers and construction of the harp since the time of the ancients. Probably the first expedient resorted to was to increase the number of strings in the octave, by adding some of the most useful chromatic notes; but the increased difficulty of playing, arising from the confusion of notes, and from the disturbance of the natural progression of the scale, has prevented any contrivance of this kind from coming into use.

In the fourteenth century an arrangement was introduced in Wales which remained until it was superseded by the better method of pedals: this was the *triple-stringed harp.* It has, as its name implies, three rows of strings, arranged in three parallel planes a slight distance apart. The two outside rows are tuned in unison with each other, and diatonically; while the inner or middle row supply the chromatic semitones. When, therefore, these notes are required, the performer inserts his fingers between the strings of the outer row, and contrivance consists of two pins, fixed on a revolving circular disc. When the pedal is loose, the pins stand in a horizontal line, and the string passes between them without touching; but, when the pedal is put down, the disc is made to revolve through a little more than a quarter of a circle; so that the pins attack the string, one on each side, and pinch it firmly between them,—the lower one then acting as a stop, and limiting the vibrating length of the chord. Of course each string is provided with two of these stopping discs,—the upper one coming into action at the upper notch of the pedal, the lower one further down.

The harp has now a compass about the same as the pianoforte, viz., 6 or 6½ octaves. In order to distinguish the notes, every C string throughout the instrument is colored red, and every F blue: the other strings are left their natural color. The material of the strings is fine catgut, carefully prepared for the purpose,—the best quality being imported from Italy. The few lowest notes are of silk, lapped with fine silver wire.

Several harps by Messrs. Erard and other makers, of the most modern construction, were contributed to the Exhibition; but they possessed no peculiarities calling for special notice.

Notwithstanding, however, all the improvement the harp has received, it still is, and probably will remain, an imperfect instrument. From the necessarily small size of the soundboard, it is deficient in resonance and *sostenuto*,—the lower notes being heavy, dead, and scarcely appreciable; while the sharp snappish sounds of the small and excessively-tightened strings, at the other extremity, can hardly be rendered agreeable even by the most skilful players. The difficulties too of execution on the harp are still very formidable, and, when chromatic passages or extensive modulations are used, become almost insuperable without more labor and practice than the effect to be obtained deserves. But the greatest evil of the harp, is the imperfect and fickle nature of the material of which its strings are composed, causing their frequent breakage, and rendering the instrument incapable of standing in tune. It is well known that a harp must be tuned afresh every time it is played on; and it is fortunate if, during a performance, the necessity does not arise either for replacing a broken string, or re-adjusting one that has gone out of tune.

With these disadvantages it might well be supposed that the harp would, at the present day, fall into disuse; but it still possesses its admirers, who, we may suppose, are attracted to it rather from its historical associations than its musical powers.

Before concluding our remarks of this department of the Exhibition, we must briefly notice the musical instruments of a smaller kind.

The Exhibition contained many examples of the violin tribe, viz., violins, violas, violoncellos, and double basses, of both English and foreign manufacture; but, as these instruments appear to have arrived at their highest grade of perfection under the hands of the celebrated Cremonese artists of the seventeenth century, and as modern makers have aimed at little beyond copying the works they left behind them, the Exhibition has afforded us no opportunity for enlarging on this class of instruments. We notice, however, two novelties. The first is a monster double bass by M. Vuillaume, of Paris, about eleven or twelve feet high, the strings of which are stopped by machinery connected with a series of levers or handles, placed immediately above the shoulder of the instrument, and within reach of the left hand of the player. It has three strings, on the Italian plan; but the depth of its pitch, or what have been the results of its trial in the orchestra, we could not learn. The other violin novelty we only mention to give it unqualified condemnation; it is an American attempt to make the violin playable with a clavier,—an attempt which, if successful, could only have the effect of depriving this noble instrument of every one of its characteristic qualities, and reducing it to a nondescript noise-making apparatus of the lowest grade.

Orchestral wind instruments have been well represented at the Exhibition; there were bassoons, clarionets, oboes, &c., by many makers; and flutes of various materials, such as wood, glass, and metal, with all sorts of improvements in the way of keys. The brass instruments were very numerous, and well exemplify the rapid improvements, and the many important novelties, which have appeared in this department of musical manufacture during the last few years. We may particularize one large case of military instruments by Messrs. Adolphe Sax and Co., of Paris. Among its contents were a new kind of instrument, called the Saxophone, speaking with a mouth-reed, like the clarionet and bassoon, but having a metal body, and a somewhat different form: it is made in three sizes, for soprano, alto, and bass. There was also a kind of monster ophicleide, called the *Sax-horn bourdon*, about ten feet high, and with forty-eight feet development of tube; also *Saxo trombas*, and various other instruments "système Sax." We must also allude to the "Sommerophone," a kind of ophicleide of much power and capability, which was played in the Exhibition by M. Sommer, accompanied on some of the organs. The introduction of the cornet-à-piston, some years ago, seems to have given, all at once, a new insight into the capabilities of instruments of this class; and we doubt not the time will soon come when, under judicious management, the late improvements will find a legitimate place in orchestral compositions. The defects of the old trumpet and horn have now become scarcely endurable, and their retention will soon be unjustifiable, when so much superior substitutes for them may be found.

In concluding our review of musical instruments we may remark, that fewer novelties have been exhibited in this department than might fairly have been expected; but the contributions were, generally speaking, excellent examples of the manufacture in its highest state of perfection; it cannot therefore be doubted that the Exhibition, in encouraging the production of instruments of the first class, and by affording an unexampled opportunity for their display, has done good service to musical as well as to industrial art.

AGRICULTURAL IMPLEMENTS.

DIGGING MACHINES.

HAVING completed our examination of the great variety of ploughs contained in the Exhibition, we now proceed to notice some substitutes therefor. It would seem that the failure of all the attempts hitherto made to turn up the ground by ploughs, actuated by steam-power, has induced a notion in the minds of many practical men, that the desired end of applying steam-power to the cultivation of the soil might be attained through a new adaptation of spade-husbandry; while others have thought that, by means of horse-power, the well-known advantages derived from the use of the spade might be economically obtained. Plans for attaining both these ends were to be seen in the agricultural department of the Exhibition.

Mr. Parsons, of Craven Farm, Stamford-hill, contributed a model of a digging machine, apparently well calculated to effect the operations of breaking up and turning over the soil. It consists of a strong iron frame, mounted on four travelling wheels (viz., a large pair and a small pair), and carrying, upon a platform, a small engine, for working the digging tools, and giving an intermittent forward motion to the machine. At the back of the machine is a horizontal bar, furnished with sockets, to receive the short stems or spindles of a series of spades or forks, for operating upon the soil;—the bar, near its ends, passes through slots or guides in the frame; and, at each end, it carries a small roller, which works in an excentric groove on the inner face of an upright wheel: hence, as these wheels rotate, the bar, with its spades, will be made to rise and fall. In order to cause the spades to enter the earth at a suitable angle when the bar descends, and also to give them a slight oscillating motion whilst entering, so as to loosen the soil, the spade-bar is provided with two fixed arms (one near each end), projecting backwards, and connected with two rods, which severally carry a friction-roller, that works in an excentric groove of another upright wheel; and, by the rotation of the wheels, the requisite movements are imparted to the spades,—such movements being similar to those usually communicated to the spade by the hands of the laborer. The stem of each spade has a short crank-arm, projecting therefrom, and jointed to a horizontal bar, which is capable of being slidden endwise, so as to turn the spades;—a strong spring, connected at one end to this bar, and at the other end to the spade-bar, serves to prevent any movement of the first bar, and to keep the cutting edges in a line with each other as they enter the earth; but, on the spade-bar rising, the end of the first-named bar comes in contact with a curved projection on the framing, and is caused to move endwise, carrying with it the crank-arms of the spades, and thereby causing the spades severally to turn over the portion of earth which each has displaced or lifted. Each time that the spades are raised from the earth, and before they descend again, the power of the engine is exerted to move the machine a short distance onward, so as to present a fresh portion of the ground to the action of the spades. The machine may be used, with suitable tools, for dibbling, instead of digging; and, in that case, the tools must not be permitted to oscillate.

A digging machine, to be drawn by horses, was exhibited by Mr. Thompson, of Great George-street, Westminster. This machine is composed of a stout wooden frame, supported by a pair of large wheels, and having at the front suitable means of attaching the horses thereto. At the back there are six spades, standing side by side in a row across the machine; they are connected, at the top, to a crank-shaft, formed with as many double cranks as there are spades to be actuated, and having half the cranks at right angles to the rest,—so that, when some of the spades are entering the soil, others are rising therefrom; and, on the lower part of the stem of each spade there are two cross arms, each carrying a small roller, which works between a pair of upright guides. By these means, as the crank-shaft rotates, not only will the spades be caused to descend and penetrate the earth, and then rise again therefrom; but, at the same time, each spade will turn upon its cross arms, so as to enter the earth at a suitable angle, and, when it rises, to lift a portion of the soil and deliver it into a vibrating scoop, which turns it over on to the earth behind it. In advance of the spades there is a row of curved coulters, which enter and divide the earth before the spades act upon it. Motion is communicated to the crank-shaft by toothed gearing from a large internal toothed wheel, affixed to one of the travelling wheels of the machine. The scoops are divided into two sets, like the spades; they are carried by two horizontal shafts, which work one within the other,—the alternate scoops being affixed to the inner shaft, and the intermediate ones to the outer shaft; and the scoops are caused to vibrate by their shafts being connected, by rods, with an excentric at each end of the crank-shaft.

CLOD CRUSHERS AND FIELD ROLLERS.

"Clod-crushers" are rollers, or combinations of rings or discs, with irregular or uneven peripheries, which are drawn over the land for the purpose of breaking the clods left after ploughing in stiff soils—for compressing the surface of light lands, so as to prevent drought, and give a firm hold to the roots of plants—for rolling corn upon light lands, as soon as sown, and likewise in the spring, after frost, in order to consolidate the soil and prevent the ravages of the wire worm and grub—for rolling grass lands and mossy lands after compost, &c., &c. "Field rollers" and "land rolls" have smooth surfaces, and are used for like purposes.

Of this class of implements, the one most extensively used is that invented by Mr. Crosskill, of Beverley, Yorkshire, which is included in the award to him, by the jurors, of a Council medal. It consists of a series of cast-iron discs or rings, with serrated edges, mounted loosely upon a cylindrical axle, so that they can turn independently of each other. These discs are provided, at each side, with lateral teeth, or cutting edges, near their periphery: which teeth are set at such an angle as to descend upon the clods in a vertical direction. The eye of every alternate disc is made somewhat larger than the axle; so that, as the roller is drawn onward, there is an up-and-down motion along its entire surface, which increases its pulverizing power, and, at the same time, prevents it from becoming clogged with earth. The axle is affixed, at the ends, by iron brackets, to a strong wooden frame, provided with shafts, and suitable means for connecting the horses thereto. A travelling wheel is fitted to each end of the axle when the implement is to be transported from one place to another; and when it is taken into the field, the earth is dug from under the wheels, until the roller rests upon the ground: the wheels are then removed.

Messrs. Garrett and Son exhibited a model of a similar implement, having the travelling-wheels fitted in such manner as to admit of the crushing-discs being readily raised from the earth, or permitted to descend and penetrate the soil to the desired depth. For this purpose, the axle-arm, whereon each travelling-wheel turns, is formed on the lower end of an upright rod, the upper end of which has a screw-thread upon it, and fits into a screw-nut, that rests on the top bar of the side framing or bracket; so that, by turning such nut, the rod, and consequently the wheel, will be raised or lowered.

Mr. Bennett, of Liverpool, contributed a model of a "self-cleaning roller," for crushing clods, rolling growing crops, and freeing land from wire-worm. It consists of two sets of rings or discs, having serrated edges and side teeth, similar to the two preceding implements, and mounted upon two horizontal axles, in a line with each other. The rings or discs of each set are connected together by means of a pin or bolt, projecting from one of the arms of every alternate disc, and entering a slot in a lug or projection upon one of the arms of each intermediate disc, so that the several discs will be caused to rotate together; but, at the same time, the alternate discs will be capable of rising and falling a short distance independently of the intermediate ones, and thereby cut the clods, which would otherwise choke the serrated edges and teeth of the discs. The rings or discs are bevilled inwards from the outer edge; so that a clod, on being squeezed in between two rings or discs, will fall into the interior of the roller, and be crushed or broken.

Mr. Gibson, of Newcastle, has obtained a prize medal for an implement which he terms the "Northumberland clod-crusher," designed to be used for breaking clods on wet as well as dry lands, also on young wheat, to prevent the ravages of the wire-worm, and to form drills for clover and other seeds. This clod-crusher has a frame like an ordinary cart-frame, with a pair of shafts in front, and two travelling-wheels, one at each side. Within the frame there are two rows of narrow iron discs or rings with smooth rounded edges, mounted upon two parallel horizontal axes. These axes are inserted, at each end, into openings in a cross-arm, which thus connects the two axes together; and each cross-arm is mounted at the centre on the axle of the travelling-wheel; so that, as the implement is drawn onward, the arms will turn and bring each row of discs successively into action upon the soil. The several discs of each row turn upon the axis, independently of each other; and the two rows intersect, so as to prevent any clogging or accumulation of soil between the discs.

A clod-crusher, exhibited by Mr. Pearce, of Poole, Dorsetshire, consists of two rows of narrow iron wheels or discs, the outer parts of which are of a zig-zag form laterally, bending angularly, first to the right, and then to the left, all round each disc. The discs turn, independently of each other, on two parallel axes, carried by a strong iron framing; and the two rows intersect. In this implement the following arrangement is adopted, to obviate the necessity of turning it at each end of the field:—The shafts for the horses are connected by an iron rod (passing through the hind ends thereof) to a horizontal frame, which is capable of turning around a centre-pin upon a similar frame, that forms part of the general framing of the implement; such upper frame is, however, in general, connected immoveably to the lower frame by two pins, which severally project through a socket in it into an opening in the lower frame; but, on arriving at the end of the field, the pins are raised by a lever-action, and the frames are thereby disconnected; the horses are then guided round to the opposite side of the implement,—the upper frame turning around the centre-pin; and, on the frames being connected again, by permitting the pins to descend, the implement commences its return across the field.

Mr. Cambridge, of Temple Gate, Bristol, contributed a very efficient implement, termed a "press-wheel roller or clod-crusher." It consists simply of a row of narrow wheels, turning independently of each other on a cylindrical axle, which is carried by brackets, from a frame similar to Crosskill's clod-crusher: the periphery of each wheel is curved upwards from each edge towards the centre, so as to form, at such part, a narrow cutting-edge, extending all round the wheel.

Mr. Starkey, of Farthinghoe, Northamptonshire, exhibited a model of a clod-crusher, capable of being converted into a plain roller at pleasure. When complete for use as a clod-crusher, it consists of a long hollow roller or cylinder, with rows of projections on its periphery, fitting on to and enclosing a roller of equal length, having a smooth cylindrical surface; and this inner roller is mounted on an axle, carried by a suitable frame, and receiving a wheel at each end when the implement is to be transported from one place to another;

but, when employed as a plain roller, the outer roller or cylinder is slidden off the smooth inner roller.

A "land-presser," stated to be particularly adapted for fen-land, was contributed by Mr. Chenery, of March, Cambridgeshire. This implement consists of a row of narrow wheels or rings, with flat or smooth peripheries, turning independently of each other on one axle, carried by a frame: at the back of which frame there are scrapers, capable of being adjusted by screws, so as to clear the wheels or rings from dirt as they rotate.

Mr. Warren, of Heybridge, exhibited an implement for rolling land, consisting of two rollers, each composed of eight small cylinders, turning freely on the same axis, which is supported at the ends by brackets, affixed to a rectangular wooden frame. The two frames are connected together side by side, in such manner that they can rise and fall separately. The two rollers do not stand in a line with each other; for the left or near-side roller is placed at the front, and the off-side roller at the back of its frame. A straight-edge or scraper is fixed over each roller, to clear off the dirt.

A cast-iron roller, exhibited by M. Claes, of Lembecq, Belgium, was included in the award to him of a prize medal. This roller consists of four cylindrical parts, turning side by side on the same axis; these parts have, at each end, a central ring or boss, supported by three radial arms; and the diameter of the opening in such ring or boss is considerably greater than the diameter of the axis that extends through the cylinders: therefore, as the implement is drawn onward, the cylinders can rise and fall independently of each other, so as to accommodate themselves to any inequalities of the surface.

There was likewise a roller in the Belgian department very like Mr. Chenery's land-presser, before described.

M. Delstanche, of Marbais, Belgium, also contributed a clod-crusher, composed, like Mr. Gibson's, of two rows of narrow iron discs or rings, with smooth rounded edges, mounted on two parallel horizontal axles, and intersecting each other; but, in this case, the axles are carried by the fixed framing of the implement, and not by moveable cross-arms; and therefore both rows of discs or rings penetrate the earth at the same time and to the same depth.

HARROWS.

The use of the "harrow," which is employed after ploughing, is to reduce the soil to a finely pulverized state for the reception of seed, also for covering seeds with mould, &c. The common harrow consists of a horizontal frame or frames, fitted with numerous strong iron teeth or tines (generally straight), which project downward, and penetrate the soil as the harrow is drawn across the field. The harrow-frames are now generally made of iron in place of wood, on account of its superior strength. A modification of this instrument is known by the name of the "Norwegian harrow," the spikes of which are affixed to bosses, and present a similar appearance to the rowel of a spur; the bosses are fixed on three horizontal spindles, in such manner that the tines of one set will work between the tines of another, and prevent them from becoming clogged; and the several sets of rowels rotate as the machine is drawn onward, and effect the pulverization of the soil. The spindles are supported by brackets from the under side of a horizontal iron frame, of a pentagonal shape, which travels on a pair of hind wheels and either a single swivel-wheel or a pair of wheels at the front. The Norwegian harrow is found to break up clods and pulverize the soil very effectually, and is particularly useful in stiff clayey soils.

There were but two Norwegian harrows in the Exhibition —one being contributed by Mr. Crosskill, and included in the award to him of a Council medal, and the other by Messrs. Barrett, Exall, and Andrewes. In Mr. Crosskill's implement, the points of the rowels are made longer and thinner than usual, so as to cut the clods and pulverize the soil better. The rowels are mounted loosely on their axle, whereby they are rendered less liable to break on meeting with stones, and the implement is capable of being turned more easily. The frame of the implement is provided with a pair of hind wheels, and a single fore wheel. The axle of each hind wheel is carried by a bell-crank lever, by means of which the spikes of the rowels are brought into contact with, or raised from, the soil. The fore end of the frame is raised or lowered by an apparatus connected with the fore wheel, and consisting of a horizontal shaft, which extends from the front to the back of the frame, and has, at the fore end, a worm, gearing into a sector rack on the upper end of the bent forked rod that carries the axle of the fore wheel. This rod is capable of turning on a horizontal axis, supported by the frame; and thus, on the worm-shaft being turned, by means of a handle at the hind end, it will, through the medium of the sector rack, cause the forked rod to assume a position more or less inclined, and thereby raise or depress the fore end of the frame.

In Messrs. Barrett and Co.'s Norwegian harrow, the fore and hind ends of the frame are raised simultaneously instead of separately, as in the preceding implement. Across the hind end of the frame a horizontal shaft extends, having at each end a descending arm, which carries, at the lower end, the axle of one of the hind running wheels; so that, when such shaft is turned, the end of each arm will describe an arc of a circle, raising the rowels from the soil as it approaches a vertical position, and *vice versâ*. The axle of the fore wheel is carried by a straight forked rod, which passes up through a socket-piece that turns on a horizontal axis supported by the frame; and according as such socket-piece and rod are made to depart from a vertical position, so will the fore end of the frame be lowered. The socket-piece is connected by two rods, one at the top and the other at the bottom, with the upper and lower ends of a bell-crank lever, or triangular piece, affixed, at its centre, to the horizontal shaft before named; so that any movement of the shaft will be communicated to the socket-piece, and thus both ends of the frame will be raised or lowered simultaneously. Motion is given to the shaft, when required, by turning a small hand-wheel, affixed to a swivel-nut, that receives the end of a screw-rod, the other end of which is connected, by a pin-joint, with the side of the bell-crank lever.

Numerous examples of harrows of the ordinary kind—viz., those with horizontal frames, carrying straight or curved descending teeth, were also exhibited. We shall first notice the expanding harrows contributed by Mr. Coleman, of Chelmsford, and which were included in the award to him of a prize medal. In these implements, five parallel beams or longitudinal bars are usually attached to the long bar of the whippletrees by draught chains. The transverse bars, which carry the straight spikes, extend in a diagonal direction from one beam to another, and are connected thereto, at each end, by pin-joints, which admit of the beams approaching to or receding from each other in the same manner as the bars of a parallel ruler, for the purpose of expanding into a coarse or contracting into a fine harrow. This change is effected by shortening or lengthening the draught-chain of the beam on each side of the central beam, so as to bring those beams nearer to the whippletree, or increase the distance therefrom. One of these harrows is provided with wheels (one to each beam) to facilitate its transport from place to place; each beam is opened out at the centre for the reception of the wheel, which is carried by a small lever, and can be lowered through the beam to the ground, or raised therefrom: the lever is jointed at the lower end to the beam, and the upper end moves between a pair of quadrant bars, which have numerous holes for the insertion of a pin to retain the lever in any required position. By raising the lever to its highest position, the wheels will be lifted from the ground, and the tines will be brought into contact therewith; and the opposite result will be obtained by the depression of the lever.

Mr. Williams, of Bedford, exhibited a set of four-beam iron harrows, for which he obtained a prize medal. The beams and transverse bars of these harrows cross each other diagonally, forming a series of diamond-shaped spaces, and the tines are fixed at the junctions of the beams and transverse bars; so that every tine will cut a separate track at the same distance from the tracks of the adjacent tines. The ends of the beams are affixed to cross bars, each connected by two chains and hooks with a long bar, to the centre of which the whippletrees are attached by a short draught-chain. By the use of double chains and hooks, the harrows are prevented from riding on each other in rough work, or when turning at the end of the "stitch or land." When at work on the side of a hill, the double chains prevent their inclining towards the lower ground.

Messrs. Howard, of Bedford, contributed several sets of iron harrows. In the first set which we shall notice, the beams (four in number) are of a zig-zag form, while the transverse bars are straight, and stand at right angles to the course of the harrow; the tines are situated at the junctions of the beams and transverse bars, are made with square shoulders, and secured to the frame by double nuts instead of single ones; each harrow is connected by double hooks to the long bar which carries the whippletrees; and the harrows are provided with hooks at the hinder part, for the purpose of drawing them the contrary way when harrowing in seeds, in order that the tines may not penetrate so deep into the soil as when drawn in the opposite direction. Messrs. Howard likewise exhibited a set of four-beam jointed harrows, constructed like those just described, except that the transverse bars do not extend across between the two middle beams; and therefore each harrow is made in two parts, connected together at the front and back by the end bars, which are jointed at the centre, so as to admit of each part rising and falling to adapt itself to any unevenness in the surface of the land. These harrows are particularly useful on land ploughed in narrow stitches, as they cling round the edge of the stitch, leaving it pulverized in a convex form, at the same time searching the bottom of the furrow. The same firm also contributed a pair of strong drag harrows, to be used on rough fallows, and constructed on the same plan as the first set above described, except that the tines, instead of terminating in a sharp point, are widened at the point, in the direction from front to back, and the lower edge thereof is curved upwards from the front to the back. These implements, when drawn forward, act as scarifiers or cultivators; and, when drawn backward, they break up the clods.

In a "four-wheel parallel-motion harrow," invented by Mr. Campbell, of Great Plumstead, Norfolk, the tines (seven in number) are affixed to an iron frame, which is suspended by four long arms from the ends of two horizontal shafts, that turn in bearings on a pentagonal frame, mounted on two pairs of travelling-wheels. The harrow-frame is connected by chains with a winch-barrel on the pentagonal frame; and by turning such barrel in one direction or the other, so as to take up or give out the chains, the harrow-frame is either raised or lowered,—it being kept at all times parallel to the surface by the long arms.

The Rev. T. Digges La Touche, of Killenaule, Ireland, exhibited a model of a harrow, consisting of a square iron frame, mounted on two wheels at the back, and a swivel-wheel at the front. The front part of the frame supports a transverse horizontal shaft, to which are hinged six long bars, extending to the back of the frame, and terminating in handles, whereby they may severally be raised when required. Each bar carries six tines, and stands at an inclination to its axis, instead of at right angles thereto; and, by reason of such inclination, each tine works in a different line. The tine-bars rest at the handle-end on the back bar of the frame; and they are kept in the proper position by the tines of each bar coming against the side of a rod, fixed in a diagonal direction between the front and back bars of the frame. Behind the harrow is an apparatus somewhat like a rake, consisting of a wooden bar, connected by rods with the back of the harrow: the bar is capable of rising and falling, and has numerous curved tines or teeth affixed thereto.

Messrs. Cottam and Hallen, of Oxford-street, contributed a "serrated chain-harrow," composed of nearly four hundred small iron discs, with serrated edges, having a hole at the centre of each, and connected together by a net-work of stout iron wire, a portion whereof passes through the opening of each disc, and serves as the axis around which the disc rotates as the harrow is drawn onward. The advantages which this harrow is stated to possess are, that, from the numerous points in contact with the soil, no clod can escape being acted upon by a large number of discs, which, as it were, saw it in pieces; while with the common harrow the clods are frepoints of different width and shape to the tines. It is capable of being easily and instantaneously adjusted; for the depth to which the tines penetrate the soil can be altered by a slight movement of the lever.

Messrs. Smith and Co., of Stamford, had a "grubber or lever cultivator, scarifier, and paring plough" which has obtained several prizes from the Royal Agricultural and other societies. It is made of wrought-iron, with seven curved tines, arranged in three rows, and bolted to the frame, which travels upon a pair of hind wheels and a small pair of fore wheels. Suitable mechanism is provided for adjusting the height of either side of the frame, to allow of the implement working on sloping ground, or with one wheel in a furrow. For this purpose, the hind wheels are respectively mounted on a pin, projecting from an arm, which is mounted loosely on the end of an axle that extends across the back of the machine. The upper end of this arm is furnished with a sector-rack, which gears into a worm on a short shaft, that works in bearings in a frame or box, affixed to the axle, and also enclosing the sector rack; and, by turning a handle fitted to this shaft, the arm is caused to approach to or recede from a vertical position, and thereby raise or lower that side of the frame. The two fore wheels are set pretty close together on a short axle, from the centre of which a round rod extends upwards, through the eye part of the draught-hook and through a socket at the fore end of the frame (in which it turns freely); and to it is attached a long lever, which is connected, at its foremost end, by a short link-rod, with the front end of the frame. This lever is also connected, at the middle of its length, by another link-rod, with the end of a horizontal lever, fixed to the hind axle. When the hind end of the long lever is pressed down, its foremost end raises the front part of the frame; and at the same time, through the medium of the second link-rod and horizontal lever, it causes the axle of the hind wheels to turn partly round, and, by moving the cranked axle-arms thereof backwards, to raise the hind part of the frame. On raising the hind end of the long lever these motions are reversed, and the frame is lowered. The retention of the lever in any desired position is effected in the usual manner.

Mr. H. Cowan, of Corstorphine, Edinburgh, contributed a five-tined two-horse "grubber" (that gained the first prize at Edinburgh, in 1848, and at Glasgow, in 1850), in which the frame is raised and lowered by somewhat similar means to those above described. The short axles of the hind wheels are carried by crank-arms, projecting from a horizontal shaft, to the centre of which a lever is affixed, by means of which the shaft can be turned, to alter the inclination of the crank-arms, and raise or depress the end of the frame. Each movement of the lever also serves to alter the height at which the fore end of the frame is supported by its single swivel wheel; for the forked arm that carries the axle of the wheel is attached to a small right-angle or bell-crank lever, which is connected by a horizontal rod with the first-named lever.

Mr. Bendall, of Woodbridge, exhibited a cultivator, having a small pair of fore wheels, a larger pair of hind wheels, and a pair of handles at the back for the purpose of guiding the implement. The upright stem or spindle that carries the axle of the fore wheels passes through a socket attached to the frame, and is fixed at the desired height by a pin passing through a hole in the socket and through one of a series of holes in the stem: by which means the fore end of the frame can be supported at any suitable height from the ground. The axle of the hind wheels is cranked at the ends, and near its centre it carries a quadrant, having a series of holes formed in it near its edge. A lever, mounted loosely on the axle, near the quadrant, is capable of being affixed to such quadrant, and consequently to the axle, by passing a pin through a hole in the lever and through one of the holes in the quadrant. When this attachment is made, by drawing back the lever, the axle will turn partly round,—causing its cranked ends to approach to a vertical position, and thereby raising the hind end of the frame to which the tines are attached. The relative position, therefore, of the lever and the quadrant will determine the depth at which the tines are permitted to penetrate the earth. When it is required to raise the tines out of action, the lever is drawn back by means of another lever, which turns on an axis at its lower end, carried by the frame, and is connected by a link-rod with the first lever. A single curved tine, carrying a broad-share, is affixed to the back of the frame; two like tines stand side by side in advance of it; and before these tines there are two other tines, placed one on either side of a subsoil share, having a long and narrow sole-plate. The upper part of the stem of each tine is notched on the back edge, and the mortise into which it fits has a small V-shaped projection or rib to fit between the notches when the wedge is driven in before the front edge of the tine.

Specimens of Earl Ducie's drag harrow, or Uley scarifier and cultivator were deposited amongst the implements of Messrs. Barrett and Co. and Mr. Crosskill. This implement has five or seven curved tines, which are set to draw lines eight inches apart, and yet are so placed as to be two feet from each other; they are fitted with moveable points or shares of various shapes, according to the work to be done; and they are fixed to a strong pentagonal iron frame, having a pair of swivel fore wheels and a pair of hind wheels on a cranked axle. The frame is raised or lowered by turning a handle on a worm-shaft, which gears into a worm-wheel or quadrant fixed on the cranked axle of the hind wheels, and thereby causes the crank-arms to approach or recede from a vertical position, and so raise or lower the hind end of the frame. Motion is at the same time communicated from the quadrant or axle, by a short connecting rod, to the hind end of a lever, which turns at its centre on a short standard, affixed to the frame, and is connected at the fore end to the upright spindle of the fore wheels. By this means the fore and hind ends of the frame are raised and lowered simultaneously.

A cultivator or scarifier, belonging to Mr. Beart, of Godmanchester, near Huntingdon, bears a strong likeness to the Uley scarifier and cultivator. The pair of fore wheels swivel on an upright stem; and the hind wheels are affixed to a crank-axle, to which is keyed a lever, having a semicircular rack on the front thereof, gearing into a pinion. By turning this pinion, the axle will be caused to rock in its bearings, and thereby elevate or depress the back of the frame. The other end of the rack-lever is connected by a long lever to the stem of the fore wheels, and through that lever effects the raising or lowering of the wheels, according to the direction in which the rack is moved. There are seven tines, arranged in two rows,—three in the front and four in the back row; and between the outer and inner tines of the back row, on each side, there is a strong star-wheel, turning on an axle, carried by stout brackets, suspended from the back of the frame: these wheels work at the same depth as the tines.

Messrs. Ransomes and May exhibited one of Biddell's wrought-iron scarifiers. The framing of this implement was originally of wood; but now it is made with cast-iron sides and transverse connecting bars of angle-iron. There are two rows of tines; and each row is included between and affixed to two angle-bars, arranged thus ⌉⌊. The upper part of each tine is made double, or with a long slot therein, to receive the stems of two hook-pieces, which extend through it in opposite directions;—one hook-piece catches hold of the top edge of the highest angle-bar, and, passing through the tine, is secured by screwing a nut on to its end; and the other hook-piece catches hold of the bottom edge of the lowest angle-bar, and is in like manner fastened by a nut.

By this mode of attaching the tines, their distance from each other, and the depth to which they penetrate, can readily be varied; and they can also be arranged to suit rounding lands. The frame is suspended in such manner from the axle of the hind wheels that either side may be raised higher than the other, to suit sloping ground, or to allow one wheel to run in a furrow whilst the tines penetrate the cultivated ground to a uniform depth. The axle of the hind wheels is straight, and forms a fulcrum for two levers, one near each end. The short limb of these levers is connected with the side of the frame; so that by elevating or depressing the longer limb of one of the levers, the side of the frame to which it is attached will be either lowered or raised: the desired position of the frame is retained by a spring-catch, which the lever carries, entering one of a series of notches or ratchet-teeth on the side framing (to prevent it rising any further), and by the insertion of a pin beneath the lever into one of a series of holes in the side framing, to prevent the lever descending. The fore part of the frame is carried by a rod, suspended from the front end of a long lever, which extends to the back of the implement. This lever turns upon an axle, carried by a bent bar, which is supported at the fore end by the upright stem that carries the axle of the small fore wheels, and at the back by a curved bar attached to the axle of the hind wheels; so that by changing the position of the lever, the height of the fore part of the frame can be readily adjusted.

Mr. France, of Stirling, contributed a green-crop grubber. This implement has a beam like a plough-beam, with a pair of handles at one end, and a small swivel-wheel at the other. To the beam, near the fore end, two side-bars are hinged, which extend towards the hind end thereof, and are kept at the required degree of expansion by means of a small bar, projecting from the inner side of each, and passing through a socket on the beam, furnished with a set screw. Each bar carries, near the fore part, a chisel-ended tine, curving forwards, and at the back a bent blade or tine, curving inwards; and a curved tine, with a wedge-shaped end, is also fastened to the beam, just in advance of the point where the side bars are jointed thereto. To the hind end of the beam a short adjustable rod is secured, and to it the fore end of a small harrow is jointed, which is thus caused to follow the implement: the harrow can be suspended, by a chain from the cross-bar that connects the handles of the grubber.

A model of a scuffler, for cleaning between the rows of green crops, was exhibited by the Rev. T. Digges La Touche. It is provided with three tines, affixed to a frame, supported at the front by a single wheel, and at the back by a pair of wheels, mounted on a cranked axle. The tines are raised from the soil by turning the axle by means of a lever, which may be retained in any required position. On releasing the lever, the weight of the frame causes the hind wheels to run back until the arms of the crank-axle come in contact with two curved bars, attached to the cross-bar of the handles of the scuffler: by adjusting such bars, the tines are permitted to penetrate the earth to a greater or less depth.

Messrs. Gray and Sons, and Mr. Tennant, contributed each a drill-grubber, with five tines affixed to an iron beam, having a pair of handles at the hind end, and a single swivel-wheel at the fore end. Messrs. Wilkie and Co. exhibited a like implement, provided with two small wheels or rollers, one in front, and the other behind; the axis of each wheel is carried by the forked end of a lever, fixed on a horizontal axis, that turns in bearings in the frame; the two levers are connected together at the upper end by a rod, so as to move simultaneously; and the axis of the hindmost lever is provided with a lever-handle for the purpose of turning it: thus, by bringing the levers into a position more or less inclined, the tines can be made to penetrate to a greater or less depth; or they can be raised free of the ground.

Amongst this class of implements we may likewise notice the model of an "Archimedean agricultural machine," deposited by Mr. D. J. Murphy, of the Chamber of Commerce, Cork, and designed to be employed for cutting, turning-up, and pulverizing the soil, and thereby prepare it, by one operation, for receiving the seed. The machine consists of a large cylinder, mounted in a frame upon a pair of running wheels; and set around it are several rows of iron blades, arranged as the threads of a screw, and intended, as the cylinder rotates, to cut and turn over the earth: the shape of the blades is varied according to the nature of the soil. The height of the cylinder can be adjusted by regulating screws, so that the blades shall penetrate the earth to any depth between one and ten inches. Behind the machine is a clod-crushing roller, which is followed by a harrow—both being connected to the machine. For working the implement, it is proposed to use (when circumstances will permit) a locomotive steam-engine of four or five horse-power.

The Egyptian department contained an agricultural implement of the following construction:—A strong wooden frame, resembling a sledge, carries three wooden rollers, one behind the other; and on each roller is fixed a series of thin discs or annular plates of iron, for cutting or scarifying the soil,—the several discs of each set working in the spaces between the discs of the other set or sets.

Messrs. Allen and Co., of New York, exhibited several cultivators. The most simple form of these implements consists of a straight wooden beam, with a pair of wooden handles affixed thereto near the middle of its length, and a straight wooden side-bar or beam jointed to it on each side at the fore end; the side-bars may be adjusted laterally by means of curved iron plates, affixed one to each bar, and projecting over the hind end of the beam, to which they are secured by a pin or key entering one of a series of openings in it. The implement is fitted with five teeth or tines, which vary in shape, according to the work to be performed, and are affixed two to each side-bar,—the fifth being attached to the beam near its fore end. An improved implement is made wholly of iron, except the beam and handles; it is furnished with a small wheel at the fore end of the beam; the side-bars, which are made of wrought-iron, are curved; and the teeth or tines are made with an eye at the top, so as to be capable of being slidden along the side-bar, and fixed at any part thereof, by inserting a wedge into the eye: the two hindmost tines of this implement are shaped like small ploughs, turning the soil in opposite directions; and, by changing their places, they can be caused to turn the earth either to or from the rows of the growing crop. Another form of cultivator has a wooden beam, furnished with a pair of wooden handles and a small wheel at the fore end, like the preceding implement; but the side-bars are of wood; and each is jointed at about two-thirds of its length from the front end, so as to admit of its bending inwards, in order that the ends thereof may be respectively jointed to the fore and hind ends of the beam;—the hinder part of each side-bar carries several straight harrow tines. On the foremost portion, just in advance of the joint, there is a single harrow tine, and also a tine which is bent at right angles at the bottom, so as to form a horizontal blade, projecting inwards; and, to the fore part of the beam, there is affixed a share resembling a gigantic broadshare, with the central part removed, so as to leave only an outer cutting-edge, about three inches wide: the share cuts up the weeds and loosens the soil, which is then pulverized by the tines.

Mr. L. Wells, of Rochester, U.S., contributed a cultivator with a rectangular wooden frame, fitted with seven tines—three in the front and four in the back row—and mounted upon a pair of wheels, one at each side. Each axle-arm is affixed to an upright rack-bar, which gears into a toothed sector on the end of a lever: by moving this lever, the axle-arm can be adjusted to any desired height; and it is retained in position by the end of a spring-catch passing through the lever and entering between the teeth of a fixed segmental rack, against the side of which the sector end of the lever moves

In the French department there was deposited the model of a scarifier with fifteen tines, affixed to a stout wooden frame; this frame is supported at the back by a pair of wheels, each capable of being raised or lowered by turning a hand-screw; and to the front of the frame is attached an inclined beam, which is supported by a two-wheeled carriage (in like manner to ploughs having a fore carriage or gallows); so that, by a lever action, connected therewith, the fore part of the frame can be raised or lowered.

Amongst the Belgian agricultural implements, M. D'Omalius exhibited a cultivator. This implement consists of a wooden beam, having a small wheel at the fore end, and at the back a double cross-beam, to each end of which a handle is affixed; the cross-beam receives the stems of two curved shares, which turn over the soil in opposite directions, and two curved tines, which stand between the shares; and to the main beam, just before these shares and tines, is fixed an iron stem, carrying at the bottom a flat pointed share and a double adjustable mould-board, the soil turned over by which is broken up by the tines.

TEXTILE MANUFACTURES.

FLAX MACHINERY.

IN a former paper we explained the various modes at present in use for retting flax; and remarked also on the after treatment of the plant by the breaker and scutcher;—our present object will be to see how far the contributions of flax machinery to the Exhibition have illustrated the progress of invention in this branch of manufacture. On consulting the Analogical Catalogue (which was so tardy in making its appearance) there would seem to be little promise of an efficient display, as the names of but three firms, known as builders of flax machinery, are set down as exhibitors in this department; while several, who are known as the inventors or proprietors of some most important improvements in machinery for the treatment of flax are wholly unrepresented. But, notwithstanding this defection, which is not easily to be accounted for, the manufacture of flax has been very fairly illustrated, as the contributions embrace a complete set of machines for carrying on the various operations, from the breaking of the flax to its final conversion into fine yarn.

With the object of giving the flax grower the means of rendering his produce fit for the market, Mr. McPherson, of Edinburgh, has constructed a portable breaking and scutching machine, suitable for a farmstead. It consists of two rectangular wooden cases, of unequal size, connected together side by side,—the smaller containing the breaking apparatus, and the larger the parts for scutching the flax. The small case is provided with a horizontal table, having a fluted surface, whereon the flax is laid; and, over the table, a fluted roller is caused to travel, for the purpose of cracking the boon, or woody portion of the flax plant. The axes or pivots of the roller move in horizontal guides, which can be lifted, by depressing a treadle, for the purpose of raising the roller; and the traverse of the roller is effected by its connection, through a rod, with a crank on the end of a short horisontal shaft, which is caused to revolve by horse or other power. The shaft also carries a spur-wheel, gearing into a pinion upon another horizontal shaft that extends through the large case. Upon this second shaft (within the large case) are fixed two discs or bosses, to which four pairs of long radial arms are bolted; and, to the outer ends of each pair of arms, is fastened a wooden beater, of a < shape, in the transverse section. At the top of the large case two channels are made to receive the clamps, in which the stricks of flax to be scutched are held to receive the blows of the beaters. The flax is first laid upon the fluted table, and submitted to the action of the traversing roller until the boon is broken up and sufficiently loosened from the fibre; it is then removed, and secured in given quantities between a pair of clamps, in such manner that one-half the length of the plant is pendent therefrom. Clamps or holders, thus filled, are successively passed into one of the channels in the large case, and, as they are pushed forward towards the other end of the machine, the stricks of flax are brought under the action of the rotating beater, whereby the pendent portion of the flax is cleared of its boon. When this is effected, the holders are removed from the channel and opened, to turn the ends of the flax; the clamps are then again tightened, and introduced into the other channel, to bring the other end, in like manner, under the action of the beaters. When the apparatus is in full operation, both channels will be full of holders; and the introduction of a fresh holder at one end is the means whereby a holder, containing a strick of scutched flax, is discharged at the opposite end. This machine, according to the statement of the inventor, is calculated, by the application of from three to four-horse power, to clean half an acre of flax per diem.

Mr. Plummer, of Newcastle-upon-Tyne, has exhibited machinery of a new construction for breaking and scutching flax, and for heckling what is technically known as "cut line." The breaker consists of a cast-iron framing, carrying five fluted rollers, of similar diameters, and connected together by gearing wheels, so that the driving of the axle of one by a band and pulley will cause the others to rotate at the same speed. This machine is provided with two platforms,—the one for conducting the flax to the rollers, and the other for guiding it out of the machine. The rollers are so arranged as to bite the flax three times during its passage through the machine; and the top rollers are weighted, for ensuring a proper amount of pressure being put upon the flax.

The scutching machine consists of a rotary vertical disc, enclosed in a casing, and carried by an axle working in suitable bearings supported by the frame of the machine. On each side of the disc radial beaters, or wooden knives, having a bevilled edge on their inner face, are affixed; but, on one side of the disc, the beaters are alternated by radial brushes,—the object being, to submit the flax, first to the action of beaters only, and then to effect the more thorough separation of the boon from the fibre by the combined action of brushes and a second set of beaters. An opening is formed in the front of the case, through which the flax is introduced by hand to the action of the beaters. When one end is cleaned, the operator turns ends, and again submits the flax to the scutching operation. By the use of a solid disc, in place of radial arms (as hitherto used) for carrying the beaters, it would seem that greater speed than heretofore applied may be used without the risk of breaking the staple, as the objection presented by the arms, of causing the flax to lash round them, and thereby get broken when working at great speed, is necessarily avoided.

The next stage of the process of treating flax, is to subject it to the action of the heckling machine, whereby the flax is combed out, and its fibres are subdivided to the extent required,—the short and entangled fibres being, at the same time, removed from the more valuable staple. The extent to which this separation is carried, is to produce a yield of only from 50 to 80 lbs. of "dressed line," as the more valuable staple is termed, out of 112 lbs. of scutched flax,—the remainder constituting the raw material known as tow, which, in general, goes to form an inferior description of yarn. If the flax is intended to be spun to a fine quality of yarn, or a "high number," it is cut into two, three, or more lengths, before being submitted to the heckling machine,—the coarser parts of the staple, that is, the extremities, being separated from the others, to form a medium quality of yarn; while the middle portions are selected for conversion into fine yarn. The action of the heckling machine, as far as the operation itself is concerned, is the same whether the long or short staple be heckled; but, to effect the operation economically, that is, without making an undue amount of tow, different constructions of machines are preferred for dressing the long and the cut line. For heckling the latter kind of staple, Mr. Plummer exhibited a machine embracing some novel points deserving of notice. It is of that class of machines which has two heckle cylinders, revolving in opposite directions, and dressing both sides of the strick of flax simultaneously; but which have hitherto met with very partial success, as the speed with which they work scarcely compensates for the waste of material they occasion,—from the fact of two sets of heckles entering the strick simultaneously, and tearing through it without the power of yielding to the entangled or interlocked fibres. Now, in order to remedy this evil in part, one of the cylinders is mounted on sliding bearings; so that each strick of flax, on being first presented to the heckle-pins, will be partially combed by the cylinder, which is mounted in stationary bearings, before the traversing cylinder approaches to act upon the strick. These cylinders are furnished with three grades of heckle-pins; and the rows of the first, or coarsest set, are alternated by rows of brushes. The motion for traversing the holders, containing the stricks of flax, through the machine, is somewhat novel and ingenious. Mounted near one end of the holder-trough (which receives its up-and-down motion for bringing the length of stricks gradually under the operation of the heckle cylinders by the ordinary arrangement of mechanism) is a short axle, which carries three pinions, two of which take into vertical racks, attached to the end framing; and the central pinion gears into a rack formed on a horizontal reciprocating bar, carried by the trough, and provided with loose pendent fingers. As the trough ascends to take in a fresh holder, the pinions, working in the fixed vertical racks, are rotated; and thus the central pinion is made to draw forward its rack with the sliding rod; by which means, the pendent fingers are brought in contact with the holders, and caused to propel them forward. On the descent of the trough, the reverse action takes place; and the reciprocating bar being slidden back, the fingers, which are hinged so as to pass back over the holders, are brought to a proper position for propelling them forward on the next ascent of the trough: this reciprocating bar is common to many heckling machines; but the mode of actuating it appears to us to be both new and simple. On the ascent of the trough, to receive another holder, and discharge, at the same time, a holder of heckled flax, the traversing cylinder is caused to retire by a simple mechanical contrivance; and thus allow of the strick of flax just received into the machine, as well as those which, in consequence, have been shifted forward to a finer set of heckle-pins, to be brought—first under the action of the heckle cylinder, which works in stationary bearings, and then under the action of the pins of the traversing cylinder, as before explained;—the ascent of the trough being made the means of driving back the cylinder, and its descent allowing of its moving forward to operate upon the flax. The heckle cylinders are cleaned as usual by rotating brushes; and an endless band of lattice-work is provided for gathering the tow into a proper receptacle. Whether or no this machine is destined to take a permanent place in our flax manufactories, a mere inspection of it, in its quiescent state, is not sufficient to enable us to judge: as regards compactness, it has greatly the advantage of the double-cylinder machines of Messrs. Lawson and Sons, of Leeds, whose contribution we shall next notice; but we can give no opinion of their relative merits in other respects.

This firm has made by far the largest display of flax machinery; and, indeed, the credit is mainly due to them that the Great Exhibition has represented this important branch of our manufactures. Their contribution may be briefly stated to have included a complete set of machinery for heckling, spreading, drawing, and roving long and cut flax; also for carding, drawing, and roving tow; for spinning coarse and fine flax yarn; and likewise for manufacturing thread. For treating short flax, a pair of cylinder heckling machines were exhibited. The cylinders, instead of being set abreast of each other, and acting simultaneously on the flax, are mounted in a line, and revolve in opposite directions; so that the flax is dressed—first on one side by one cylinder, and then on the opposite side by the other cylinder. The objection to this arrangement is, as before indicated, the want of compactness; as machines, working on this principle, are required to be double the length of those which turn the strick and heckle both sides on the same heckle-pins, or heckle it simultaneously on both sides. To remedy this objection, however, Messrs. Lawson apply two troughs to the machine; and are thus enabled to submit two rows of stricks to the action of the same rotating heckle cylinder. The mode of traversing the flax-holders through the machine is analogous to that described in reference to Mr. Plummer's machine, and therefore need not be repeated. The cylinders are furnished with two grades of heckle-pins; and, between each row, rising and falling plates (which take their motion from excentrics) are fitted, for the purpose of determining the depth that the heckle-pins shall enter the stricks. Between the rows of the finer grade of heckles, small flat brushes lie at right angles thereto; and these brushes, being set in one edge of the rising and falling plates, form a sort of bed for the flax to lie on while under the action of the heckles. The stricks, in passing over one cylinder, are heckled on one side; they are then brought under the action of the second cylinder, which, revolving in an opposite direction, will finish the other side of the strick. The machine, exhibited by this firm, for operating upon long fibre, is provided with two endless bands of heckles, set side by side, and arranged so as to present an inclined surface to the flax. These bands are set at opposite inclines, and revolve in different directions, for the purpose of operating upon different sides of the stricks of flax. Guide-bars are also provided, to determine the depth that the heckle-pins shall enter the flax.

These are the only arrangements of heckling machinery which the Exhibition contained. It must, therefore, be considered as very deficient in this respect; as the rival inventions of Messrs. Marsden, of Manchester, and Messrs. Combe, of Belfast, for turning the stricks of flax, and causing them to be operated upon on both sides by the same cylinder (which have recently been the cause of so much litigation) are unrepresented. So also is a still more recent improvement of Messrs. Combe, for heckling both sides of the strick without turning, by the use of but one cylinder. In this machine (which we had recently an opportunity of seeing in action at Belfast) the means of operating on both sides of the strick is obtained by merely reversing the direction of rotation of the cylinder while the trough is ascending to take in a fresh holder. Another arrangement of a promising character for heckling both sides of the strick one after the other while passing once through the machine, has recently been devised by Messrs. Harding, Cocker, and Co., of Lille; but, as this machine was not included in their contribution to the Exhibition, we conclude that it is not yet brought into the market.

The flax, after leaving the heckling machine, is slightly combed by hand and sorted into parcels, according to the quality of the staple; it is then packed away in a cool dry dark room; and, by lying there for a few months, its quality is said to improve. When the flax is taken from the "dressed line store," it is subjected to the action of the following machines, for the purpose of converting it into yarn,—viz., 1st. The first drawing-frame or spreader, the use of which is to convert the flax, as delivered from the heckling machine, into a continuous sliver or band of filaments. 2nd. The second drawing-frame, by which the sliver is attenuated. 3rd. The third drawing-frame, whereby several slivers from the second drawing-frame are united together and re-drawn, to obtain a finer sliver, with greater regularity of fibre. 4th. The roving-frame, which further elongates the sliver, and converts it into a spongy cord or roving. 5th. The throstle-frame, which extends the spongy or loose roving, and spins it into yarn. The flax drawing-frame is very different in construction to that formerly described as employed for drawing cotton, although the action is precisely analogous. Its construction and mode of operation may be thus briefly described:—At the back of the machine is an endless travelling feed-cloth, on which the stricks of flax are laid, so as to overlap each other, and which carries the flax to what are termed the "back holding-rollers." In front of these rollers, and arranged parallel thereto, is a series of "gills," or straight bars furnished with heckle-pins, whose office is to receive the flax as it is delivered from between the holding-rollers, and carry it forward to the drawing-rollers. These gills are supported and traversed by their extremities taking into the threads of two screw-shafts, set at right angles to the holding-rollers, which shafts, as they rotate, carry the gills forward. When they have arrived at the end of the shafts they severally fall, and are received by a pair of screw-shafts below, having a quicker thread, which carry them back to the holding-rollers; and a "sweep," on the ends of these shafts, lifts the gills up again into gear with the upper screw-shafts. Thus an endless chain, as it were, of gills is provided, which, having a somewhat greater speed than the holding-rollers, combs the flax straight, and delivers it with perfectly parallel fibres to the drawing-rollers. By these the sliver is drawn to the requisite fineness, and then, passing between a pair of calendering rollers, it is delivered to a can. The cans of sliver, thus produced, are now set up behind the second drawing-frame, to undergo the second operation. This frame, and also the third, are similar in construction to the first,—the only difference being, that they are fed from cans, instead of by a cloth; and, as the process of drawing out the sliver advances, the size of the working parts are required to be less, and the fineness of the gills to be increased. The operation of drawing is the same in all cases; but, in the second and third frames, the sliver is doubled, to give it an evenness, or structural equality, as it is elongated.

Messrs. Lawson have exhibited screw-gill-spreaders (as the first drawing-frame is termed) for both long and cut flax; also gill-frames for completing the drawing of the long and short fibre; but, further than being well made machines, they present no points for comment.

Messrs. Higgins and Sons have also exhibited a screw-gill-spreader, and a second drawing-frame, for long line. In the former of these machines the front top rollers are weighted by an arrangement of compound levers, which is said to have the advantage of convenience over the ordinary plan; and, in the latter, the rollers and gills are driven at the middle instead of from the side of the machine; thus relieving the rollers of a great portion of the strain to which they are ordinarily exposed, and permitting of the use of smaller rollers, which, for some descriptions of work, is considered of importance. The sliver, as it is delivered into cans from the third drawing-frame, is taken to the roving-frame, to be still further reduced, and wrought into a loose thread; but, as this operation is precisely similar, whether for long line, cut line, or tow, it may be well to explain briefly the means of bringing tow to a proper state for undergoing the first spinning process, before speaking of the roving-frame. The tow, which we have said is the short and irregular fibres combed out of the strick of flax by the heckling machine, is subjected to the action of a carding-engine, somewhat similar in construction to that used for carding cotton. It consists principally of a large central cylinder, covered with wire-cards, and surrounded with card-rollers, termed "workers" and "strippers," revolving in contact therewith. The tow is carried into the machine by an endless travelling cloth, which delivers it to a pair of feed-rollers, situate below the main cylinder; whereby it is transferred to the large cylinder. By this it is brought under the action of the workers, which comb or card it; and it is then stripped or "doffed" from the cylinder by card-rollers, which, in their turn, are relieved of the staple by doffer-combs; these take it off in the form of a sliver; and it is eventually delivered from the machine, by delivering-rollers, into cans. In order to prevent the liability of the sliver breaking, by being pressed down into the cans, and also to avoid the necessity for using a separate machine for performing the first drawing operation, it has lately been the practice to apply one or more gill drawing-heads to the carding-engine, according to the number of strippers employed, and slivers produced, and to carry on the carding and first drawing processes simultaneously. This is the arrangement of Messrs. Lawson and Son's carding-engine. It is provided with three strippers, which are capable (by being set at different distances from the main cylinder) of taking off different lengths of staple from the card surface; and thereby sorting out or dividing the qualities of the tow. In this machine, however, there is but one gill-head; all the slivers, therefore, are united in the first drawing process, and form, together, a continuous sliver: the completion of the operation of drawing tow is precisely similar to that already described with reference to long and cut line.

To obtain a flax roving, it is usual, after drawing the sliver to the required amount, to put in a slight twist. Messrs. Higgins exhibited a roving-frame with six heads and sixty spindles, for producing rovings of this kind. This roving-frame is, in fact, to describe it shortly, a drawing-frame, with the addition of spindles; the gills and rollers being driven according to their improved plan, before noticed.

The roving-frame for cut flax, exhibited by Messrs. Lawson, is intended to produce a roving without twist, which, for obtaining fine qualities of yarn, is very desirable: the gummy matter in the flax is here taken advantage of to give the roving the necessary cohesive property. A correct notion of the construction of this roving-frame may be best conveyed by tracing the progress of a sliver through the machine. The sliver passes from the can over a pulley through fixed guides over travelling gills, between a pair of drawing-rollers, then into a trough containing hot water (for the purpose of dissolving the gummy matter in the flax), thence over a heated cylinder which dries the staple, and, finally, it is wound on to a bobbin which rests upon and runs in contact with a horizontal fluted roller. Rovings thus produced are capable, it is said, of being drawn to almost any degree of fineness, with little reference to the material; because, while one fibre can be glued to another, at any portion of its length, a roving can be made. Messrs. Lawson also contributed machinery for wet and dry spinning, viz.,—a dry tow spinning-frame, with 100 spindles; a fine spinning-frame, for spinning the roving through cold water; a double water-frame, with 136 spindles; and a double twisting-frame, with 96 spindles. The only noticeable novelty in these machines (the construction of which will be understood from the description already given of cotton spinning machinery) is a new tape motion for driving the spindles. A spinning-frame, by Messrs. Higgins, containing 144 spindles, was also exhibited; but, further than being a specimen of good design and workmanship, it calls for no special remark.

RECENT PATENTS.

To JOHN CORRY, *of Belfast, in the Kingdom of Ireland, damask manufacturer, for improvements in machinery or apparatus for weaving figured fabrics; which machinery or apparatus is also applicable to other purposes for which Jacquard apparatus is or may be employed.*—[Sealed 2nd January, 1851.]

THIS invention relates to an improved construction of Jacquard apparatus. The general objects of this invention are, to dispense with the necessity of painting or drawing the pattern or design on ruled pattern paper, of reading off the pattern and cutting it on cards, and of afterwards attaching the said cards together in the form of an endless chain, as is now generally the case. In fact, the cards, the reading and cutting machines, and, consequently, the operation of lacing the cards together, are all dispensed with; and, in lieu thereof, the patentee employs perforated metallic sheets, containing the drawing of the design or pattern intended to be produced on the fabric.

The pattern is drawn upon a piece of ordinary paper, which may be attached to the perforated metallic sheet before or after it has received the pattern; and all those parts of the design which require to be perforated are punched out by the hand with punches of various kinds. By this means, the pattern is as distinctly represented on the perforated metallic sheet as it was formerly on the ordinary ruled pattern paper; and the perforated metallic sheet can be at once placed in the machine, and used to produce the pattern on the fabric.

The construction, arrangement, and mode of working the horizontal and vertical wires or needles, which are acted upon by the perforated metallic pattern, are considerably modified, so as to render the Jacquard apparatus much simpler than heretofore.

The following is the manner of preparing the perforated metallic sheet, which is used in place of the ordinary chain of perforated cards:—A sheet of thin zinc or other metallic substance is perforated, by mechanical means, with regular lines of holes, in somewhat the same manner as that adopted for making perforated zinc window-blinds. The sheet of zinc or other metal is to be perforated in straight parallel rows; and the holes to be made therein, for the arrangement shewn and hereafter described, are preferred to be about one-sixteenth of an inch apart from each other, measuring from centre to centre, so that the sheet will be perfectly covered with holes, set at equal distances apart. These distances may, however, be altered (if required) to suit other machines. Along each side of the sheet a row of larger holes is made, at about one-eighth of an inch distant from each other. These holes are intended to receive the pins or points of a roller, whereby the sheet of zinc (when adapted to the Jacquard apparatus) may be guided and moved forward in a regular and accurate manner; and by the rotation of this roller a row of holes, in the perforated pattern, is brought immediately before the ends of the horizontal needles hereafter described. On a sheet of perforated zinc or other metal, thus prepared, a sheet of paper, parchment, or other similar substance, is pasted; and on this paper or parchment is drawn the design or pattern intended to be produced on the fabric. This being done, the paper or parchment is rubbed over with a burnisher, or similar instrument, in order that the marks of the holes in the metal sheet may be shewn on the surface of the paper; and the outline of the pattern or design is punched out,—that is, the holes of the metal sheet, covered by the pattern or design, are opened by means of punches; and the perforated sheet is then ready for use in the machine.

In order to facilitate the punching operation, it will be found convenient to combine several punches together, so that from one to twenty or more holes may be made at one blow, when the nature of the work will admit of it. This is a matter of convenience, which may, however, be left to the operator; as the same effect may be produced by the use of a single punch.

The improvements in the construction and arrangement of the Jacquard apparatus, which is intended to be operated by the perforated metallic pattern above described, are shewn in several views in Plate V., wherein fig. 1, represents an end elevation of the Jacquard apparatus; fig. 2, is a plan view of the same; fig. 3, is a partial front elevation,—some of the parts being shewn in section; and fig. 4, is a transverse vertical section of the principal working parts. The stationary framework, which supports the principal working parts, is shewn at *a*, *a*, *a*. At each end of the shaft *c*, which is mounted in bearings at the back of the machine, is a lever or arm *b*, whereby the griff and other parts of the machine, connected therewith, are lifted, when required, by means of the tail-lever *f*, which is mounted on the shaft *c*. When this lever *f*, is depressed, the outer end of the lever *b*, is brought against the under side of the bowl or antifriction roller *d*, at the end of the comb or guide-reed *e*, *e*, through which the vertical wires a^1, are passed. The griff, for raising the vertical wires a^1, is shewn at *g*, *g*, and is connected with the comb or reed *e*, *e*, by tubes *p*, *p*, which run on fixed vertical rods *o*, *o*, at each end of the machine. The perforated metallic pattern is shewn at *h*, *h*, figs. 1, and 2. It passes over breast-rollers or shafts *i*, *i*, at the back of the machine, and is moved forward by the roller *k*, which is furnished with teeth or points, as shewn in the drawing. These teeth enter the large holes made along the sides of the metallic sheet; and the pattern is kept in its place on the roller *k*, by means of the pressing-roller *l*; and by the rotation of the roller *k*, the perforated pattern is carried into and through the machine.

At fig. 4, e^1, e^1, are the horizontal needles, which are acted on by the perforated metallic sheet *h*: these needles e^1, e^1, are mounted in a frame, composed of two brass guide-plates c^1, and d^1, which are pierced with holes to receive the horizontal needles e^1, and are secured, in any convenient manner, to the bar i^1. In constructing this part of the apparatus, care must be taken that the holes for the horizontal needles are accurately drilled in the guide-plates at equal distances, so that each horizontal needle shall be exactly opposite to one of the perforations in the metallic sheet, and also to its corresponding upright hooked wire a^1. The holes in the back guide-plate d^1, are counter-sunk, in order to receive the heads of the needles. The vertical wires a^1, a^1, are hooked at one of their upper ends, and, being bent round somewhat in the form of the letter U, they have a certain amount of elasticity, and therefore act as springs; so that their hooked ends are always kept against the surface of the guide-plate d^1, except when any of them are pushed back by the needles e^1, as shewn at fig. 4. The wires a^1, a^1, are further held in their relative positions by means of the guide-pins *x*, which are passed through holes made in the plates d^1, and t^1, and are driven into a strip or block of wood h^1, immediately behind the latter. The parts t^1, and h^1, are secured to the bar y^1; and this bar is connected with the bar i^1, by means of bolts, nuts, or screws f^1, f^1. The lower ends of the bent wires a^1, rest upon and are supported by a pair of bars *w*, *w*, between which the strings k^1, of the harness pass.

Figs. 5, and 6, represent a modification of the arrangement shewn at fig. 4,—the principal difference being that the bent wires a^1, are arranged in two rows, one behind the other,—the needles e^1, still remaining in a single row. The needles for operating on the back row of wires are, of course, of greater length than the others, but act against the wires precisely in the same way as the arrangement shewn at fig. 4. The advantage of this modification is, that stronger bent wires a^1, may be used than when they are all arranged in one row.

The pressing-roller *l*, and also the roller *k*, which carries forward the perforated metallic pattern, are mounted in bearings in a sliding frame *j*, *j*, and are furnished with adjusting screws r^1, r^1, for the purpose of bringing the rollers *k*, and *l*, together, and adjusting the metallic pattern. A reciprocating or backward and forward motion is communicated to the sliding frame *j*, *j*, in its bearings *q*, *q*, by a bowl *n*, which is connected with the griff. A socket *m*, is secured on the sliding frame *j*, *j*, by screws or otherwise, and carries a slotted frame m^1, in which the bowl *n*, works, as the griff is moved up and down.

The action of the apparatus is as follows:—Upon depressing the lever *f*, at the front of the machine, the levers *b*, will act against the bowl *d*, and raise it and the comb or reed *e*, together with the hollow rods *p*, and griff *g*, in a vertical direction on the fixed rods *o*, *o*. By this motion, the bowl *n*, (which is connected to the griff) will be raised in the slot of the frame m^1; and, by the peculiar form of the slot, the frame m^1, and socket *m*, and, consequently, the sliding frame *j*, *j*, will be pushed back, and the bent wires a^1, which have been selected, will be raised by the griff. When the latter descends, the bowl *n*, will pull forward the sliding frame and its appendages, and, by that means, bring the surface of the perforated metallic pattern on the roller *k*, against the ends of the needles e^1, which project through the guide-plate c^1, fig. 4. It will now be understood, that when the perforated pattern is brought against the ends of the needles e^1, such of the latter as happen to be opposite to holes in the metallic sheet will pass through and remain stationary, while those needles which are opposite to unperforated parts of the sheets will be pushed back. Upon the griff again rising, the hooks of those wires a^1, which have not been pushed back by the needles e^1, will be carried up, as shewn by dots at A, fig. 3, while the other wires will remain down, as shewn at B, in the same figure. When the griff descends, the bowl *n*, pushes back the slotted frame m^1, the socket *m*, and sliding frame *j*, with the roller *k*, and the metallic pattern, as before mentioned; and by this backward motion the ratchet-wheel G, on the axle of the roller *k*, will be brought against the fixed pall *s*, and thereby pushed round one tooth, and thus bring another line of holes in the metallic pattern opposite the ends of the needles e^1: a repetition of the same operations will then take place until the whole pattern is completed.

The patentee remarks, that the apparatus may be adapted not only to any loom for figured weaving, to which the ordinary Jacquard apparatus is applicable, but it may be applied, in place of the ordinary Jacquard, to lace machinery for making figured lace. The mode of applying the ordinary Jacquard apparatus to lace machinery for figuring lace being well known, and as the improved Jacquard apparatus is applied in precisely the same manner, it is unnecessary to give any detailed explanation of the mode of application. He also states, that an apparatus to be worked by means of perforated cards, in the same manner as the Jacquard apparatus, has been sometimes employed in connection with machinery for printing yarns or warps, for the manufacture of carpets and other figured fabrics,—the use of such apparatus being, to select the stamps, whereby the warp or yarn is printed with divers colors, according to the pattern. His improvements are equally applicable to this purpose; and, in fact, to any purpose where the ordinary Jacquard apparatus can be employed.

The patentee claims, First,—the use (as a substitute for the cards of an ordinary Jacquard apparatus) of a perforated metallic sheet, covered with paper, parchment, or other similar material, on which is painted, drawn, or traced, the pattern or design intended to be produced on the figured fabric; and which pattern or design, so painted, drawn, or traced, on the paper, parchment, or other similar material, is afterwards punched out by means of suitable punches; and thereby holes or perforations are produced, which answer the same purpose as the holes punched in the ordinary cards. Second,—the general arrangement of the parts of the Jacquard apparatus shewn and described; whereby the bent wires, to which the harness is attached, may be arranged in a single row, or not more than two rows, in place of such wires being arranged in several rows, as has hitherto been the case. He also claims the combination of the needles e^1, with the bent wires a^1, or any modification thereof, in which the heads or ends of the needles are made to bear against the bent wires,—such bent wires being, at all times, kept in contact with the heads or ends of the needles, by the bent portion thereof acting as a spring. And, further, he claims the exclusive use of needles which act by their heads or ends against the hooked wires from which the harness of a Jacquard loom is suspended, instead of employing needles with a loop or eye thereon, or attached thereto, to receive the stems of the hooked wires, as is usually the case.—[*Inrolled July,* 1851.]

To ROBERT BROWN, *of Liverpool, in the county of Lancaster, plumber and brass founder, for improvements in, and the application of, pumps for raising or forcing water.*—[Sealed 19th November, 1850.]

THIS invention consists in a novel construction and arrangement of pumps, whereby an economy, considering their capacity for work, is effected in the manufacture, and the liability of the pump to clog or become deranged in its action is considerably reduced. One peculiarity in this improved pump is, that two cylinders may be supplied with water, at opposite ends alternately, from two inlet valves, instead of four, which would be required to effect the same object according to the ordinary arrangements. A further improvement consists in so arranging the inlet valves that they may be readily got at without displacing any of the working parts of the pump.

In Plate V., the improved construction of pump is shewn in several views. Fig. 7, is a sectional elevation, taken through the middle of the cylinders; fig. 8, is a sectional plan, taken in the line 1, 2, of fig. 7; fig. 9, is a section, taken in the line 3, 4, of fig. 8, and shewing the inlet passages and valves set in the vacuum chamber; fig. 10, is a cross section, taken in the line 5, 6, of fig. 8; and fig. 11, is a horizontal section, shewing the connection of the cylinders with the central water-ways. A, A, is a vacuum chamber, forming the foundation for the pump; and through it runs a perforated supply-pipe B, which prevents any large extraneous matters from entering the pump. This pipe is closed with a cap at one end, which is made removable, to facilitate the cleaning of the pipe. The chamber A, is closed at top by a cast-iron cover C, shewn best at fig. 8. Cast on the under side of this cover, and forming part therewith, are pipes D, D*, which are provided with valves, and form the inlet passages for the water; and on the upper side of the cover are sunk channels, which form the water-ways for connecting the inlet passages, the cylinders, and the central water-ways together. The pipes D, D*, are closed by a clamp *a*, and screw-cap *b*, as shewn at fig. 9; and as these caps are quite free of the upper parts of the pump, they may be readily removed to get at the inlet valves, without disarranging any other parts of the pump. The cover C, of the vacuum chamber carries the cylinders E, E*, and also a central column F, which is divided vertically by a partition *c*, into the compartments 1, 2. Passages of communication 1*, and 2*, are formed between the compartment 1, and the cylinder E, and the compartment 2, and the cylinder E*; and these compartments or water-ways are respectively closed by the exit-valves 3, and 4. Above the central column F, is a hollow pillar G, in connection with which is the discharge-pipe H; and a continuation of the bottom flange of this pillar, at either side thereof, forms the heads for the cylinders E, E*. Through these heads the piston-rods I, work, as usual; and they are retained in a vertical position by passing through guides carried by the pillar G. The upper end of the cylinder forms a bearing for the pump-beam K, which is connected to the piston-rods by rods L, and is worked by levers in the ordinary way.

The mode of working of the improved pump is thus described:—Suppose the chamber A, to be supplied with water, the up-stroke of (say) the piston in the cylinder E*, will form a vacuum in that cylinder, and cause the water to rise up the inlet-pipe D*, and follow the piston. The descent of the piston will close the inlet valve, and force the water along the horizontal curved channel (see fig. 8,) to the division 1, of the central column F; it will then rise up that column, and, forcing open the valve 3, enter the pillar G, and find its way out at the discharge-pipe H; but when flowing out at the valve 3, it will meet with a stream that is being driven upwards from the cylinder E, by the piston of that cylinder; and the discharge of both supplies will be effected together. The way in which the water is supplied to the cylinders E, E*, above the piston, is as follows:—The action of the pistons is alternating, and the upper part of each cylinder is connected with the bottom of the other through the compartments 1, 2, in the central column F, as will be clearly understood on inspecting the figs. 10, and 11. At the same time, therefore, that the piston of the cylinder E*, moved upwards, and formed a vacuum beneath it, the piston in the other cylinder descended: whereby a vacuum was formed in the cylinder E, above the piston. Now, as the pipe D*, communicates both with the cylinder E*, and the compartment 1, (as shewn best at fig. 8,) the water which passes up that pipe, at every other stroke of the pump, is divided into two streams, which respectively pass into the cylinder E*, below the piston, and into the cylinder E, above the piston: the reverse motion, therefore, of these pistons simultaneously propels the two streams of water out at the valve 3, and thence into the discharge-pipe H. The like action takes place when the supply enters at the pipe D: the valve in the pipe D*, is then closed, and the water flows under the piston in the cylinder E, and above the piston of the cylinder E*; and on the reverse action of these pistons taking place, it is forced out at the valve 4, into the pillar G, and thence runs off through the discharge-pipe H.

The patentee claims the general arrangement and construction of double-cylinder pump, as above described. And, particularly, he claims the means whereby he is enabled to supply both cylinders simultaneously, at one side of their pistons, from one and the same valve, and at the same time discharge the supply at the other side of the pistons simultaneously through one and the same valve.—[*Inrolled May*, 1851.]

To Alfred Vincent Newton, *of the Office for Patents*, 66, *Chancery-lane, in the county of Middlesex, mechanical draughtsman, for an invention of improvements in the preparation and manufacture of caoutchouc or India-rubber,—being a foreign communication.*—[Sealed 9th July, 1850.]

These improvements in the preparation and manufacture of caoutchouc or India-rubber consist in compounding or combining the gum called gum-lac, or gum-shellac, or seed-lac, or stick-lac, with caoutchouc or India-rubber. The materials are combined in various proportions, according to the purposes to which the compound is to be applied. Sometimes one part of caoutchouc is combined with from one to eight and more parts of gum-lac or shellac; and sometimes one part of gum-lac or shellac is combined with from one to eight parts of caoutchouc. The greater the proportion of caoutchouc employed, the more elastic the compound will be; and the greater the proportion of gum-lac or shellac employed, the stiffer, harder, and less elastic will the compound be. The two ingredients are mixed together, mechanically, by grinding or trituration, or by means of their solvents, in the manner well known to manufacturers of caoutchouc. Among the advantages to be derived from the combining of gum-lac or shellac with caoutchouc are—an economy in the manufacture, and the prevention of the disagreeable odour which generally pertains to India-rubber compounds.

When the compound is intended to be used in the manufacture of any thin fabrics, it has been found useful to mix with it a small quantity of finely-divided sulphur, either by grinding or triturating the sulphur with the compound, or by mixing with the compound a solution of sulphur in a solvent of sulphur, or by applying the finely-divided sulphur in the form of dust or powder to the surface of the thin fabrics. The proportion of sulphur thus employed is very small: it may be about one pound of sulphur, finely divided, to one hundred pounds of the compound. The fabrics, made of the compound thus mixed with sulphur, or dusted with sulphur, should be exposed to the rays or heat of the sun until the compound is deprived of its tackiness.

Gum-lac or shellac, when combined with caoutchouc, by means of camphine and other solvents, makes a useful cement for many purposes. To make this cement, one part of gum-lac or shellac is mixed with two parts of caoutchouc, by grinding or triturating them together in the usual manner; and then a sufficient quantity of camphine, or other solvent of caoutchouc is added, to render the compound of the proper consistency. A small quantity of finely-divided sulphur is generally mixed with the cement;—say two or three ounces of sulphur to one pound of the composition used.

When the compound of gum-lac or shellac, prepared with finely-divided or dissolved sulphur, is used to make thin fabrics, and generally when the compound is to be used in thick fabrics or masses, the inventor submits the compound, so prepared, to a high degree of artificial heat (say about 270° of Fahrenheit's thermometer), for the purpose of curing or vulcanizing the prepared caoutchouc,—following the processes described in a patent granted January 30th, 1844, to William Edward Newton, for improvements in the preparation of caoutchouc or India-rubber, and in manufacturing various fabrics, of which caoutchouc forms a component part. In general, the inventor employs the heating processes commonly used in treating caoutchouc, so as to vulcanize or cure it, as it is called; and, before submitting the compound, so prepared with sulphur, to a high degree of artificial heat, he sometimes mixes with it such ingredients as are now commonly mixed with vulcanized caoutchouc (such as sulphur, earths, oxides, or carbonates, or salts of lead or zinc, or other metals), in the proportions commonly used by manufacturers of caoutchouc.

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* For description of this invention see Vol. xxv. of our present Series, p. 252.

The patentee claims, as the invention communicated to him, the use of gum-lac or shellac, in its various forms, in the preparation or manufacture of caoutchouc or India-rubber, with or without the application of artificial heat, substantially in the manner and for the purposes above specified.—[*Inrolled January*, 1851.]

To Robert Olddiss Bancks, *of the Firm of Bancks Brothers, of Weirhouse Mill, Chesham, in the county of Bucks, and* 20, *Piccadilly, London, paper-makers and card-makers, for improvements in the manufacture of paper.*—[Sealed 30th November, 1850.]

In the manufacture of all hand-made papers, for the purpose of writing or printing upon, and of much machine-made paper, for the like purposes, it is the practice to form therein a device, name, and date, or some of them, known as the water-mark. These marks are produced by attaching to the surface of the mould or dandy-roller, employed in the manufacture of paper (usually by sewing with fine wire), cylindrical and sometimes flattened wire, previously formed into the designs or marks intended to be produced in the paper; which designs or marks, thus attached to and lying above the general surface of the mould, occupy a space thereon, which, if they had been absent, would have been charged with pulp, and thereby cause the sheet of paper in progress of manufacture to be thinner at the particular parts of the mould where the marks or designs are attached, by the thickness of the wire used in the same marks or designs; and the same apparent effect is indeed produced upon the sheet of paper in progress of manufacture as is produced by an ordinary die on any substance it may be caused to act upon,—with this difference, however, that on the sheet of paper the impression is the sunken one.

It is obvious, from the use of cylindrical wire, or flattened wire, having its sides parallel with each other, that the mark ultimately produced will be formed of a number of lines of equal breadth; unless, indeed, in the same figure, wires of different gauges, thicknesses, or breadths, be employed; and even in the latter case (which, indeed, in practice, it is believed seldom occurs), the transition from the different gauges would be abrupt and ill adapted to the proposed end. Also in forming designs of intricacy with wire, a frequent crossing of it is necessary; by which means, at the points of crossing, the mark will necessarily be the thickness of two wires, and, consequently, the water-mark on the sheet of paper will be stronger at those points; or, if to avoid the crossing, the wire be cut, so that an end might abut against the length of the wire in an intricate design, the pieces of wire would be so short and so numerous as to render the sewing or fastening of them to the mould exceedingly difficult and of great expense, and, in some cases, wholly impracticable. With respect to the imitation of hand-writing, or the introduction of fac-simile autographs as water-marks, it is scarcely necessary to observe, that the observations before made, in relation to general designs, will apply with greater force to them; and that, at the best, they would be very imperfect, and, in many cases, could not be effected at all. The remarks made, with reference to the water-marking upon moulds, is equally applicable to dandy rollers.

The object of this invention is to remedy the defects before pointed out, and to produce a simple mark, or one of the highest ornamental character or intricacy; the lines of which may vary from a thin line or faint shade to one of a greater depth of tone or breadth; or, on the contrary, from a depth of shade to a fainter one; and also to afford facility for introducing water-marks of the greatest intricacy, without the inconvenience or expense, before alluded to, of crossing the wire, and thus rendering some parts thicker than the main body of the mark, or cutting the wire into innumerable small pieces.

These effects are attained by the following means, whereby also the patentee is enabled to produce fac-similes of ordinary hand-writing, and of autograph signatures:—A plate of brass, copper, or other metal, being provided, of the requisite substance to produce the depth of water-mark impression in the pulp (which substance must be determined according to the required weight or thickness of the paper)—to one side of this plate is to be attached, by glue or other suitable means, a piece of card-board or veneer of wood, for the purpose of giving it rigidity and support; and the design to be produced in the pulp as a water-mark, having been drawn on paper, is then to be affixed, by glue or other suitable means, to the other surface of the plate. If the sheets of paper to be manufactured are not required to be very heavy, the plate may be thin; and two thin plates of metal may be attached together, and be operated upon at one time. In this case, the paper, with the draught of the design, may be affixed to the outer surface of one of a pair of plates, previously attached together by glue, or other matter, having a piece of card-board or veneer of wood between them, for the purpose of keeping the two thicknesses of metal in contact, and for giving them rigidity. The plate, supported as stated, or the pair of plates, connected as described, is or are then to be pierced or perforated round the outlines of the device by a saw, adapted to the purpose (after the method of cutting buhl work), according to the pattern or design drawn as before mentioned. The plate or plates having been so pierced, perforated, or cut to the figure of the device, those portions of the metal intended to form the device or water-mark, are then to be disengaged from the parts of the plate or plates not required: which having been done, the drawn paper device, card-board, or veneer, must be removed; and if two plates of metal have been cut at one operation, they are to be separated from each other: this separation, as well as the removal of the drawn paper device, card-board, or veneer, can be effected by soaking in hot water or other suitable means. The designs or patterns, thus produced, are now to be attached to the surface of the mould or dandy-roller employed by the paper-maker: which may be done either by sewing with wire, as in the ordinary method of attaching water-marks to moulds or dandy-rollers, or by solder.

In cases where a high finish to the water-mark or design is required or desirable, the edges, and such other parts of the metal as may be desired, should be chamfered-off, rounded, or cut down. In order to do this, the metal devices or parts of the plate or plates are to be affixed, by some sufficient means, to a rigid block, to hold them whilst operating upon: the method which the patentee has adopted, is to glue the cut metal device to a flat slab of marble, somewhat larger than the device; and this admits of its being readily removed by soaking in hot water, after the operation, next described, has been performed. The pattern or metal device being thus affixed, the upper surface thereof is then to be dressed by cutting or filing at the parts where it may be necessary, to improve the effect of the pattern; and the edges which have been left sharp by the saw can be removed or rounded by the scorper or engraver's tool, and then finished off by stoning or other suitable means. The above method of finishing the marks or designs applies only where the device is to be sewn on to the mould or dandy-roller with wire; but when solder is used, the metal device may—after having been cut, as before mentioned, and cleared from the other parts of the cut plate, card-board, or veneer—be at once affixed by solder to the mould or dandy-roller; and the dressing may be then effected by the scorper or engraver's tool, and the subsequent operation of stoning be performed, as before mentioned.

The patentee claims, as his improvement or improvements in the manufacture of paper, the adaptation of marks or devices, pierced or cut from plates of metal, or other suitable substance, by saws or other instruments, as described, to the moulds or dandy-rollers used in the manufacture of paper, for the purpose of producing water-marks therein.—[*Inrolled May,* 1851.]

INSTITUTION OF MECHANICAL ENGINEERS, BIRMINGHAM.

The following paper, by Mr. C. W. Siemens, of Birmingham, was next read:—

On a new regenerative condenser for high-pressure and low-pressure steam-engines.

The condenser of a steam-engine has for its object the complete discharge of steam from within the working cylinder, after it has served to propel the piston. This is effected by conducting the expended steam into a closed chamber, containing an extended surface of comparatively cool substance, which absorbs the latent heat of the steam, and thereby reduces it to a liquid state. Cold water is generally employed for this purpose, and is either brought into immediate contact with the steam, as is the case in Watt's injection-condenser, or else it acts through the medium of metallic walls, as in the surface-condenser by Hornblower, improved upon by Hall and others.

The more or less perfect condensation of the steam depends,—1st, on the absence of air from the condenser; and, 2nd, on the temperature at which condensation takes place.

In order to produce a perfect vacuum, the water should leave the condenser at about 32° Fahr., or be introduced in the form of ice. Condensing water, however, is generally obtained at the temperature of about 60° Fahr., and it leaves the condenser at about 110° Fahr.: which latter temperature implies a remaining atmosphere of vapour equal to 2·5 inches of mercury, or, in other words, a vacuum of 27·5 inches below the atmospheric pressure at 30 inches. If a less quantity of condensing water be used, it will be raised to a proportionately higher temperature, and a less perfect condensation be effected. At 212° Fahr., the pressure of the uncondensed vapour would be equal to that of the atmosphere, and the object of the condenser would be entirely frustrated.

In all cases where an abundant supply of condensing water cannot be obtained, or where the heat of the steam employed by the engine is reclaimed for other purposes, steam-engines are worked without a condensing apparatus (or at high pressure), at the sacrifice of an effective pressure nearly equal to that of the atmosphere upon the working piston, The *regenerative condenser* (the subject of the present paper) redeems the engine from this waste of heat in the one case, and loss of mechanical effect in the other case; as it possesses the peculiar property of returning the condensing and condensed water at the initial temperature of the steam previously to its discharge from the working cylinder (commonly speaking, at 212° Fahr.), and effects, nevertheless, an efficient vacuum.

In Plate V., fig. 12, shews a sectional elevation of the regenerative condenser, as applied to a 10-horse-power high-pressure engine. It consists of an upright rectangular trunk of cast-iron *a*, the lower end of which *b*, is cylindrical, and contains a working piston. The trunk is filled with vertical metallic plates, set parallel to each other, with intervening spaces of not less than $\frac{1}{16}$th of an inch in breadth. The upper extremity of the condenser communicates on one side *e*, with the exhaust-port of the engine, and on the other with the hot-well *f*, through a valve *g*. A stop *h*, prevents the opening of the valve beyond a certain distance, in order that it may re-shut instantaneously. The metallic plates *d*, are fastened together by five or more thin bolts, with small washers between the adjacent plates, which keep them the required distance apart. They can easily be removed from the condenser, for the purpose of cleaning, by taking off the cover *i*, and drawing out the whole of the plates. An injection-pipe *k*, enters the condenser immediately below the plates: it is provided with a small air-vessel *l*, and a regulating cock.

The action of the regenerative condenser is as follows:—Motion is given to its working piston by the steam-engine, causing it to accomplish two strokes for every one of the engine. At the moment when the exhaust-port of the engine opens, the plates *d*, are completely immersed in water, a small portion of which has entered the passage above the plates at *a*, and is, together with the air present, carried off by the rush of steam through the valve *g*, into the hot-well, where the water remains, while the excess of steam proceeds into the atmosphere. An instant after the partial discharge of the steam cylinder has commenced, the water recedes between the plates *d*, and exposes them gradually to the steam, which condenses upon them. As the upper edges of the plates emerge from the receding water, they are enveloped in steam of atmospheric pressure; and, in condensing a portion thereof, they become rapidly heated to nearly the temperature of the steam, or about 210° Fahr. The partial condensation diminishes the density and temperature of the remaining steam, which requires additional and cooler surfaces for its further condensation. This is provided for by the continual emerging of additional portions of the metallic surfaces from the water. By the time the water-level leaves the plates, the greater portion of the steam is condensed. The condensation of the remaining portion of the steam could not so readily be accomplished by means of metallic surfaces; but the piston *c*, continuing to descend, puts it into immediate contact with the jet of cold water from the pipe *k*, which completes the vacuum, in the manner of a common injection-condenser. The air-vessel *l*, connected with the injection pipe, has the effect of accumulating the injection water when the water has ascended between the plates, and of forcing it into the condenser with increased intensity when it is required to complete the vacuum.

Although the action of this condenser is strictly consecutive, yet it does not check the continuous flow of steam from the cylinder, and it completes the vacuum when the working piston of the engine has only accomplished one-tenth part of its stroke. Both the engine-crank and the crank driving the condenser are on the top centre at the same moment; but the latter completes its revolution in the time of half a revolution of the engine: consequently, when the engine-piston has passed only one-tenth of the whole stroke, the condenser-crank will have travelled through nearly half its stroke, and the whole process of condensation will have been completed. The principal part of the latent heat of the steam is stored up in the plates, the upper extremities of which are heated to 210° Fahr., and the lower to about 150° Fahr.

The water, in re-ascending between the plates during the last tenth part of the stroke, absorbs heat therefrom in a similar successive manner (passing first the coolest, and, by degrees, the hottest portions of their surfaces), and issues finally into the upper steam passage at a temperature approaching the boiling point; at which moment a fresh discharge of steam takes place, which carries it off into the hot-well, as above described, and raises its temperature fully to the boiling point.

Various modes have been provided to give motion to the displacing piston, among which a knee-motion, worked directly from the beam or cross-head of the engine, is generally found the most convenient, as shewn at *m*, *m*, in fig. 1.

The quantity of condensing water required with this condenser to condense one pound of steam, of atmospheric pressure—taking the initial temperature of condensing water at 60° Fahr., the final temperature at 210° Fahr., and the latent heat of steam of 212° Fahr. at 960 units—is

$$\frac{960}{210-60}=6\cdot6 \text{ lbs.}$$

of water to condense 1 lb. of steam; whereas, the common injection-condenser (supposing the condensing and condensed water to issue at 110° Fahr.) requires

$$\frac{960+(212-110)}{110-60}=21\cdot2 \text{ lbs.}$$

In the case of a locomotive or other high-pressure engine, where the steam is released from the cylinder at a pressure of, say, 30 lbs. above the pressure of the atmosphere, two-thirds would be allowed to escape uncondensed, and a vacuum be obtained with only $\frac{66}{3}=2{\cdot}2$ lbs. of condensing water for every 1 lb. of steam passed through the cylinder.

The small quantity of condensing water required, renders the proposed condenser applicable to engines in nearly every locality; and pains have been taken to render the apparatus itself equally light and compact. The advantages resulting from its application to high-pressure engines are thus stated:—

1. Additional effective power is gained on account of the vacuum. This the inventor sets down at 20 per cent.

2. Heat is saved in generating the steam, by the use of boiling-hot feed water; and the remaining portion of hot water may be advantageously used for heating buildings, dyeing, &c. This is said to be equal to about 15 per cent.

3. The steam which is not condensed may be used to cause a draft in the chimney, or for other purposes.

4. The displacing cylinder, unlike the air-pump of the injection-condenser, abstracts no motive power from the engine.

5. The condenser may be started and stopped at any time, by turning the supply of injection water either on or off. If turned on, it at once forms the vacuum, without involving the necessity of blowing through; and if turned off, it allows the engine to proceed in the same manner as though no condenser had been applied.

6. The air contained in the condenser is, at the commencement of each stroke, bodily expelled, which is of great advantage to the formation of a good vacuum; whereas, the ordinary air-pump removes only a portion of the air at each stroke, and, consequently, leaves a portion always in the condenser.

7. The regenerative condenser is more compact, and even less expensive than the ordinary injection condenser,—being less than one quarter of the size, and having only one valve instead of three.

The advantages attending the application of the regenerative condenser to stationary engines having been practically proved, the author is desirous to extend the same also to that important class, the locomotive engine. In inviting the attention of railway engineers to this inquiry, he is prepared for practical objections being raised, on account of the great rapidity of motion, the necessity for the greatest possible simplicity and lightness, the deficiency of condensing water, &c.; but he thinks that the condenser under consideration is well adapted to meet these objections.

Its peculiarities in this respect are:—That it may be accommodated to any speed of piston, by reducing the length and increasing the breadth of plates, and reducing the velocity of the displacing piston proportionately. Its dimensions are proportionate to the capacity of cylinder only, and not (like other condensers) to the horse-power of the engine. The total weight of a pair of condensers, as applied to a locomotive engine, with cylinders of 13 inches diameter, and 20 inches stroke, is about 3¼ cwt. The power of the blast remains nearly undiminished.

The condenser requires no attention in working the engine, and in case it should fail to act, from any accidental cause, the engine will continue to work as a high-pressure engine; and moreover it does not interfere with the working parts of the engine.

The advantages which would result from a vacuum in the cylinder of a locomotive engine have been ably set forth by Mr. Edward Woods, in his "Observations on the Consumption of Fuel and Evaporation of Water in Locomotive and other Steam Engines."—The present paper may therefore be limited to the means proposed for that purpose.

The two condensers are cast in one piece, and placed immediately in front of the cylinders of the engine. Each of them closely resembles the condensers above described, only the length of the plates and the stroke of the displacing pistons are much reduced in proportion to the steam cylinder, in order that the velocity of the water between the plates may not exceed certain limits.

The two displacing pistons are connected to opposite ends of a short vibrating beam, which receives its motion from the engine.

In addition to the exhaust-valves leading into the hot-well, these condensers are provided with a second set of discharge valves, of a somewhat peculiar construction, which, with very limited motion, combine the advantage of opening a perfectly clear passage for the exhaust steam of the engine into the chimney, where its remaining expansive force is required to produce draft. This valve consists of a longitudinal rectangular slot, in the upper wall of the steam passage which leads from the cylinder to the condenser; and at the ends of the slot are triangular pieces, supporting the sides of two longitudinal lips, which cover the aperture, except at such times when a superior pressure from within forces them open. The extent of their motion is limited by dead stops.

The escape of steam, together with the hot water, into the hot-well, is regulated by a blow-off valve from the latter into the atmosphere: by this means a pressure above that of the atmosphere is obtained in the hot-well, which acts favorably in forcing the boiling-hot condensing water into the feed pump of the boiler. It has been stated above, that the ordinary supply of feed water is of itself not quite half sufficient to maintain a vacuum within the condenser, and an additional supply of water must be provided for. Considering, however, the smallness of the excess of condensing water, especially if the diameters of the working cylinders are reduced in proportion to the additional effective power gained, and considering that boiling-hot water will readily part with the principal portion of its heat, it is proposed to take it back to the tender through a simple refrigerator, in which advantage is taken of the rapid motion of the engine through the air for cooling the water. The refrigerator may be placed conveniently on the back of the tender.

The application of the proposed condenser to low-pressure engines requires but a short notice, after what has been said already. In this instance, the steam, at the time it is released from the cylinder, has not sufficient force to expel the air and heated water from the condenser into the atmosphere; and a partially vacuous space must therefore be provided for their reception. For this purpose, that side of the displacing cylinder which, in the arrangement hitherto described, is always empty, is put in communication with the exhaust-valve of the condenser, and receives the charge of water and air when the piston is at the opposite end; and a second valve is provided, through which the water is expelled into the hot-well during the return of the piston. For the convenience of arrangement, the displacing cylinder is reversed.

The chief advantages obtained by the application of this condenser to the low-pressure engine are:—

1. The requisite amount of injection water is reduced in the proportion of 3 to 1. 2. The feed water of the boiler is obtained nearly boiling hot, which constitutes a saving in fuel of $\frac{210-110}{1960}$ about 10 per cent. 3. The whole amount of heat generated under the boiler is given off by the engine in the form of water, at 210° Fahr., which, in most cases, may be advantageously employed for heating buildings, for washing, dyeing, and other purposes. 4. A large proportion of the power required for working the air-pump is saved.

The author concludes his paper with a short historic sketch of the steam-engine condenser, to illustrate the distinct features of this proposed system.

In Newcomen's engine, he says, the condensation of the steam was effected by the introduction of a jet of cold water into the steam cylinder itself. The cold water naturally cooled the walls of the cylinder, which in their turn condensed a large portion of the succeeding charge of steam before it had forced the piston upward.

James Watt, in seeking a remedy against this loss of heat, conceived the possibility of condensing the steam in a separate closed vessel; and, in carrying his idea into effect, he not only realized his immediate object, but at the same time rendered the steam-engine susceptible of that degree of perfection and general application of which it is now possessed. The injection condenser of Watt is the most effectual of its kind, and has maintained its exclusive dominion to the present day. It consists of a closed vessel, which communicates periodically with the steam cylinder. The injection water, together with the condensed steam, and the air, which is partly evolved from the injection water, and partly leaks in through the joints of the cylinder and exhaust-pipe, are continually discharged from it by means of the air-pump. Shortly after the introduction of Watt's condenser, a surface condenser was proposed by Hornblower, consisting of a close annular vessel of thin metal plate, on the inner surfaces whereof the waste steam of the engine was condensed;—its latent heat being continually carried off by a stream of cold water which surrounded the vessel. A comparatively small air-pump was provided, which served to discharge the condensed water (to be again forced into the boiler) and any air which might leak in through the joints. This condenser failed in practice, for want of sufficient cooling surface.

An effective surface condenser would, however, possess considerable advantages over the injection condenser, especially in the case of marine engines; for, by returning the condensed steam continually into the boiler, it prevents incrustation of the latter, and, moreover, dispenses with the necessity of blowing off; its air-pump absorbs a much smaller proportion of the power of the engine; and its functions require less personal attention. Stimulated by these considerations, several attempts were made to improve on Hornblower's invention; but, since all these improvements partake very much of the same character, it is thought sufficient for the present purpose to mention only Hall's condenser, which has obtained the greatest amount of notoriety. It consists of two flat chests, or close chambers, connected together by means of a large number of brass tubes, through which the condensing steam circulates. These tubes are surrounded by cold water, which fills up the space between the flat chests. A small air-pump removes the condensed water and air from the lower chest. The great weight and costliness of this condenser, its liability to derangement, and the impossibility of removing the calcareous deposit of the water from the tubes, without taking the whole fabric to pieces, are found to be heavy practical objections.

In the year 1847, the author had occasion to apply a surface condenser in a situation where economy of space and material were essential. In considering the most rational distribution of surfaces, he happened to find an arrangement which, with less than one half the amount of material used in Hall's condenser, produced a very satisfactory result, and which paved the way to the more important improvement which forms the principal subject of this paper.

The surface condenser referred to, consists of a number of copper plates, of $\frac{3}{32}$ inch thickness, and about $4\frac{1}{2}$ inches broad, by 2 feet long, which are fixed together with two longitudinal flattened wires, of the same metal, between the adjacent plates; and the whole pile is screwed up tight together between the sides of a rectangular cast-iron vessel, which constitutes the body of the condenser. The ends of the plates project through the top and bottom of the condenser, and are planed flush with its exterior surfaces. The joints at top and bottom are secured by means of India-rubber rings, which are screwed down under small cast-iron frames, and yield to the difference of expansion between the two metals. The flattened wires are laid parallel, about 3 inches apart from each other, and form, with the plates, a large number of narrow passages, through which the cold condensing water flows in an upward direction, without entering the vacuous space of the condenser, into which the edges of the plates outside of the flattened wires project, forming the condensing surfaces.

The *rationale* of this condenser is as follows:—The transmission of heat in a surface condenser is three-fold. 1. From the condensing steam to the internal metal surfaces. 2. From the internal surfaces, through the body of the metal, to its external surfaces. 3. From the external surfaces to the surrounding water by which it is carried off.

The first-named operation (condensation) would, it is presumed, proceed with undefined rapidity, if it were not retarded by the second and third, or by the presence of some permanent gases, which accumulate on the condensing surfaces, and prevent their immediate contact with the steam. The second (conduction) varies in direct proportion with the conducting power of the metal, and with its thickness; but the conducting power of copper is so great, that its thickness seems to exercise no appreciable influence on the amount of heat transmitted in a given time.

The surface condenser, above described, was arranged in accordance with these observations.

It contains:—Heat-absorbing surfaces (by the water), 18 sq. feet per horse-power; condensing surfaces, 9 sq. feet per horse-power; computed mean thickness of metal through which the heat is transmitted, 1¼ inch; weight of copper, 60 lbs. per horse-power; space occupied by plates, 0·4 cubic feet per horse-power,—about one-tenth part of the space occupied by the tubes in the tubular condenser.

The advantages of this condenser are, its comparative cheapness of construction, and the easy access which is afforded to the water channels between the plates. It also requires less condensing water than previous surface condensers, in consequence of the repeated and close contact in which each particle is brought with the heating surfaces, before it can reach the upper reservoir, or hot-well. The author considers that the surface condenser, just described, may be advantageously applied to marine engines, and not being subject to a patent, he hopes it will receive a sufficient trial.

Being required to save the waste steam of a low-pressure engine, in the form of slightly-heated water, by Mr. John Graham, of Manchester, the author, in the spring of 1847, conceived the idea of a regenerative condenser. It consisted of a revolving valve, which admitted the waste steam of the engine, first, to the atmosphere, and, successively, into separate closed compartments, where it was condensed at various densities. The cold water entering at top, first passed between the plates within the last compartment, and by degrees between those in the other compartments, until it reached the first compartment, where the steam was of nearly atmospheric pressure, and consequently heated the water to nearly 212° Fahr., at which heat it passed off.

The next step was an injection condenser, on the same principle.

The revolving valve admitted the waste steam of the engine, first to the atmosphere, and then successively into the separate compartments, where it was condensed at various densities. The cold water injected into the apparatus passed down through the steam in each compartment in succession, by means of displacing pistons, which worked all on the same piston-rod through each of the divisions between the compartments; and the heated water passed out at bottom.

The several compartments were provided with overflow distributing trays, for the purpose of bringing the water more rapidly and completely in contact with the steam; and a small pump was used to extract the air that was mixed with the steam and water.

The regenerative condenser, in its present form, partakes of the nature of both the surface and injection condensers.

In answer to an inquiry as to what difference had been found in the consumption of fuel in the engine at the Saltley Works, by the use of the condenser?—Mr. Siemens stated that the experiment had been tried with one week's working with the condenser, and then one week without it; and the saving of fuel with the condenser was at the rate of 18 per cent. The apparatus with which the condenser worked was, however, too light, and had not been made for the purpose; also, that condenser was the first that had been made, and the proportions had been improved in the subsequent ones.

This statement was confirmed by Mr. Wright, who said that the saving in fuel amounted to about 8 cwt. in 1¼ days. There had been irregularities in the working of the engine, and several stoppages had occurred from defects of the apparatus, which was too light.

The Chairman thought that, in a locomotive engine, the extraordinary rapidity with which the jets of steam were discharged constituted a great impediment to the application of the condenser.

Mr. Siemens replied, that it would only be necessary for the condenser to work quick enough to condense one cylinder-full of steam before the next cylinder-full was discharged; and this he thought would easily be effected by widening the plates of the condenser to a proportionate size, and shortening the stroke of the condenser piston, so as to reduce its velocity as far as might be required. It would then return to the tender in pipes, between which air was caused to circulate by means of the rapid motion of the engine.

The Chairman observed, that there would be difficulty in keeping the water of the tender cool enough for condensing, when there was very little left in the tender; and the water remaining at the end of the journey would be very hot, and nearly boiling.

Mr. Siemens replied, that he expected the condensing water would be cooled down to about 100°, before it was returned to the tender, by the process of passing through the pipes of the refrigerator, from the rapid motion of the engine through the air; and the water was not required to be so cold as in the ordinary condenser; as only the last portion of the steam was condensed by injection.

Mr. Cowper observed, that only a small portion of the steam reached the injection water, the greatest portion being condensed previously, by the metallic plates, or discharged into the atmosphere: therefore the injection water might be about the same temperature as it usually came from the ordinary condenser. Also, the tender would not get empty so soon as usual; because a portion of the steam was condensed and returned back into the tender, instead of the whole being blown up the chimney: this gain might amount to one-third of the water employed.

Mr. Siemens shewed, by a comparative indicator diagram, that, with the application of the condenser to a locomotive engine, the steam might be cut off at about one-third of the stroke, instead of at two-thirds, as usual; and thereby a saving of one-half the steam would be effected, with the same power.

The Chairman said, the subject of the application to locomotive engines was one of great importance, and he hoped it would be brought before the Institution in another paper. He proposed a vote of thanks to Mr. Siemens for his paper, which was passed.

The following paper, by Mr. E. A. Cowper, of Birmingham, was then read:—

On an improved mode of moulding railway chairs.

In laying before the Institution a short account of a new mode of casting railway chairs, it is thought that no apology is necessary for the introduction of such an apparently dry matter of detail, as it has ever been the great aim and object of this Institution to thoroughly discuss, and, as far as possible, pass a sound practical judgment on, mechanical inventions affecting the interests of the public generally.

The improved mode of casting railway chairs is confidently submitted to the judgment of the members; and as the invention is simply a cheaper mode of producing better castings, it may be described in a very few words.

The iron pattern of the railway chair is provided with cast-iron chill-plates, which are made so as to give the required form to the inside of the casting.

The pattern being placed in the moulding box, the chill-plates are placed therein, one in contact with each jaw of the pattern. The sand is now thrown into the box, and some of it is rammed between the chill-plates,—thus effectually securing their close contact with the pattern; and the remainder of the sand is then rammed in, until the box is full. The box and its contents are then turned upside down, in the usual way; and the pattern is slightly rapped, and then withdrawn, by means of a screwed lifting-pin: the chill-plates being left in the sand, form a good guide to the pattern as it is withdrawn. The top box is next put on, having been previously rammed up on another board, technically called an "odd-side board;" and the melted metal being poured in, the casting is effected. As soon as the metal has thoroughly set, the casting may be turned out; and the chill-plates will drop out of themselves.

A mould box, which had been rammed up in the manner described, was exhibited to the meeting: the chill-plates were shewn as firmly imbedded in the sand, and some force was necessary to displace them.

The chill-plates are simply good castings, made from an iron pattern, and are not filed up, or fitted in any way, as the iron pattern of the chair is fitted to them, and the metal chills being closely pressed by the sand against the metal pattern, great accuracy is obtained in the position of the chills; indeed, it is a very rare thing for the shape or inclination of the jaws of the chair to vary anything like 1-32nd of an inch: therefore, when the wrought-iron rail is placed within the chair, the correct inclination is accurately given to it; and if the rail be true, the chairs cannot be winding, or out of their parallel.

It is found that the chill-plates stand exceedingly well; and in fact many hundred tons may be cast off one set of them. This is partly owing to their not being very thick, so that they soon get hot through, and do not strain or warp at all: the chairs are chilled just sufficiently to give a good true face, but are not chilled-in very deep, in consequence of the chill-plates not being very thick, and the chairs themselves containing a large quantity of metal.

On this plan of casting chairs, boys only are employed for moulding; as the great ease and safety with which the pattern is withdrawn entirely does away with the necessity of regular moulders being employed: thus the cost of manufacturing railway chairs is brought to a minimum.

In conclusion, the author stated that many thousand tons had already been cast on this plan, and that it bids fair to be universally adopted.

Mr. Cowper exhibited specimens of the chairs, the patterns, and the process of moulding. He said that by that process of casting scarcely more than one in five hundred wasters were made.

In answer to an inquiry from Mr. Slate, Mr. Cowper observed, that the saving in the casting would be about four shillings per ton.

Mr. Middleton inquired, what was the difference in the plan of casting chairs from that of Messrs. Ransome and May?

Mr. Cowper explained, that their plan was to have an iron plate or chill fitting the side of the box, and the chill-block fixed into that by a small dovetail. This block had to be driven out before the chair cooled, and the chairs sometimes were strained by the contraction before the block could be got out, and were liable to be broken or injured; but in his plan there was no strain in cooling. Also, his plan ensured the inclination of every chair being quite correct, because the chill-plates were held so firmly; but in that of Messrs. Ransome and May, there was a degree of uncertainty in the inclination, from the block being held only at the side. He might mention, that they had so far approved of his plan as to arrange for adopting it in their manufacture. His chair could be made perfectly parallel inside, but in their chair there was obliged to be a little taper inside, to allow of driving out the block after it was cast. In the old chairs they were compelled to use taper keys, which frequently got loose; but with this chair the keys could be used quite parallel, and when they became swollen by the moisture, they formed a head at each end, which prevented the keys from ever getting loose.

The Chairman observed, that Mr. Cowper's plan appeared to be a decided improvement, both in the accuracy of casting the chairs, and in economy of manufacture.

New Patents

SEALED IN ENGLAND,

1851.

To Leman Baker Pitcher, of Syracuse, in the State of New York, in the United States of America, Gent., for improvements in apparatus for regulating motive power engines. Sealed 2nd October—6 months for inrolment.

James Warren, of Montague-terrace, Mile End-road, in the county of Middlesex, Gent., for improvements applicable to railways and railway carriages, and improvements in paving. Sealed 2nd October—6 months for inrolment.

Thomas Cussons, of 51, Bunhill-row, in the county of Middlesex, for improvements in ornamenting woven fabrics for bookbinding. Sealed 2nd October—6 months for inrolment.

William Henry Ritchie, of Kennington, in the county of Surrey, Gent., for improvements in ornamenting glass,—being a communication. Sealed 2nd October—6 months for inrolment.

William Hodge, of St. Austell, Cornwall, printer, for improvements in the manufacture of glass, china, porcelain, earthenware, and artificial stone. Sealed 2nd October—6 months for inrolment.

Joseph Pimlott Oates, of Lichfield, in the county of Stafford, surgeon, for certain improvements in machinery for manufacturing bricks, tiles, quarries, drain-pipes, and such other articles as are or may be made of clay or other plastic substance. Sealed 9th October—6 months for inrolment.

James Frederick Lackersteen, of Kensington-square, in the county of Middlesex, Gent., for improvements in obtaining motive power. Sealed 9th October—6 months for inrolment.

Sir John Scott Lillie, Knight, Companion of the Order of the Bath, of Pall-mall, in the county of Middlesex, for improvements in forming or covering roads, floors, doors, and other surfaces. Sealed 9th October—6 months for inrolment.

Henry Curzon, of Kidderminster, in the county of Worcester, civil engineer, for improvements in the manufacture of carpets and rugs. Sealed 9th October—6 months for inrolment.

Henry Briggs, of Primrose-street, Bishopsgate-street, seed-crusher, for improvements in oil lamps, and in apparatus for lubricating machinery,—being a communication. Sealed 9th October—6 months for inrolment.

Thomas Taylor, of the Patent Saw Mills, Manchester, for certain improvements in apparatus for measuring water and other fluids. Sealed 9th October—6 months for inrolment.

Robert James Mary'on, of York-road, in the county of Surrey, Gent., for improvements in obtaining and applying motive power, and in signalizing. Sealed 10th October—6 months for inrolment.

Richard Archibald Brooman, of the firm of J. C. Robertson & Co., of Fleet-street, London, for certain improvements in the preparation and treatment of fibrous and membraneous materials, both in the raw and manufactured state, whereby they are rendered more durable; are contracted or expanded; are cleaned; and are more capable of resisting decomposition and of receiving and retaining colors. Sealed 10th October—6 months for inrolment.

Hubert Sommelet, of Paris, in the Republic of France, manufacturer, for certain improvements in the manufacture of scissors. Sealed 10th October—6 months for inrolment.

Thomas Lightfoot, of Jarrow Paper Mills, South Shields, in the county of Durham, paper manufacturer, for improvements in machinery applicable to the manufacture of paper. Sealed 16th October—6 months for inrolment.

Thomas Henry Fromings, of the firm of Lomas, Fromings, & Co., of Sheffield, in the county of York, manufacturers, for improvements in forge-hammers. Sealed 16th October—6 months for inrolment.

Matthew Gibson, of Wellington-terrace, Newcastle-upon-Tyne, for improvements in machinery for pulverizing and preparing land. Sealed 16th October—6 months for inrolment.

William Onions, of Southwark, in the county of Surrey, engineer, for improvements in the manufacture of nuts and bolts; also of steps, bearings, axles, and bushes; also of mills and dies for engravers; also of bells, lathe, and other spindles; also of weft-forks, shuttle-tongues, and lips for looms; also parts of agricultural implements, chains, roller-guides, and throstle-bars, by the application of materials not hitherto used for such purposes. Sealed 16th October—6 months for inrolment.

Thomas Perry, of Tower-street, in the borough of Leicester, machinist, for improvements in the manufacture of looped fabrics. Sealed 16th October—6 months for inrolment.

Richard Dover, of New-street, Spring-gardens, in the City of Westminster, merchant, for improvements in treating sewage, in obtaining products therefrom, and combining such products with other matters. Sealed 16th October—6 months for inrolment.

Richard Roberts, of Manchester, engineer, for improvements in machinery or apparatus for regulating and measuring the flow of fluids; also for pumping, forcing, agitating, and evaporating fluids; and for obtaining motive power from fluids. Sealed 17th October—6 months for inrolment.

Ephraim Hallum, of Stockport, in the county of Chester, cotton spinner, for certain improvements in preparing and spinning cotton and other fibrous substances. Sealed 22nd October—6 months for inrolment.

John Ramsbottom, of New Mills, in the county of Derby, engraver, for certain improvements in machinery or apparatus for measuring and registering the flow of water and other fluids or vapours; which machinery or apparatus is also applicable to registering the speed of and distance run by vessels in motion; and for obtaining motive power and other similar purposes. Sealed 22nd October—6 months for inrolment.

Joseph Beattie, of Lawn-place, Lambeth, engineer, for improvements in the construction of railways, in locomotive engines, and other carriages to be used thereon; and in the machinery by which some of the improvements are effected. Sealed 22nd October—6 months for inrolment.

William Boggett, of St. Martin's-lane, Gent., and George Holworthy Palmer of Westbourne Villas, Paddington, civil engineer, for improvements in obtaining and applying heat and light. Sealed 22nd October—2 months for inrolment.

John Platt and Christian Schiele, both of Oldham, in the county of Lancaster, machinists, for certain improvements in machinery or apparatus for the preparation and manufacture of fibrous materials; which improvements, or parts thereof, are also applicable for the transmission of fluids and aeriform bodies. Sealed 22nd October—6 months for inrolment.

Donald Henderson, of Glasgow, ironmonger, for an improved apparatus for generating gas; which apparatus may be used for heating, and other similar useful purposes; and other apparatus for heating and ventilating. Sealed 23rd October—6 months for inrolment.

John Henry Pape, of Paris, in the Republic of France, for improvements in ploughs. Sealed 23rd October—6 months for inrolment.

Jonathan Sparks, of Conduit-street, Bond-street, in the county of Middlesex, surgical bandage-maker, for improvements in or substitutes for laced stockings or bandages for the legs. Sealed 23rd October—6 months for inrolment.

Henry Adcock, of Northumberland-street, Strand, in the county of Middlesex, civil engineer, for improvements in the manufacture of pipes, chimney-pots, and hollow vessels; also bricks, tiles, copings, columns, and other articles used in building houses and other structures. Sealed 23rd October—6 months for inrolment.

Moses Poole, of the Patent Bill Office, London, Gent., for improvements in axle-boxes for railway carriages,—being a communication. Sealed 23rd October—6 months for inrolment.

Allen Searell, of Tanybwlch, in the county of Merioneth, engineer, for improvements in sawing machinery. Sealed 23rd October —6 months for inrolment.

William Adolphus Biddell, of St. John's-square, Clerkenwell, in the county of Middlesex, founder, and Thomas Green, of No. 4, Trafalgar-square, for certain improvements in moulding, casting, ornamenting, and finishing articles and surfaces. Sealed 29th October—6 months for inrolment.

Frederick Crace Calvert, of Manchester, Professor of Chemistry and analytical chemist, for improvements in manufacturing iron, and in manufacturing and purifying coke. Sealed 30th October—6 months for inrolment.

Michael Scott, of John-street, Adelphi, civil engineer, for improvements in punching, rivetting, bending, and shearing metals, and in building and constructing ships and vessels. Sealed 30th October—6 months for inrolment.

CELESTIAL PHENOMENA FOR NOVEMBER, 1851.

D.	H.	M.	
1			Clock after the ☉ 16m. 15s.
—			☽ rises 2h. 19m. A.
—			☽ pass mer. 6h. 50m. A.
—			☽ sets 11h. 27m. A.
	2	3	☿ in conj. with ♃ diff. of dec. 0. 15. S.
3	19		☽ in Apogee
4	18	53	Pallas oppo. ☉ intens. of light 1·493.
5			Clock after the ☉ 16m. 14s.
—			☽ rises 4h. 3m. A.
—			☽ pass mer. 10h. 23m. A.
—			☽ sets 3h. 49m. M.
7	2	8	♄ in conj. with the ☽ diff. of dec. 2. 23. N.
	4	49	♅ in conj. with the ☽ diff. of dec. 4. 13. N.
	9	30	☿ in sup. conj. with the ☉
	23	0	☿ in the descending node
8	11	21	Ecliptic oppo. or ○ full moon
10			Clock after the ☉ 15m 57s.
—			☽ rises 5h. 35m. A.
—			☽ pass mer. 0h. 37m. M.
—			☽ sets 8h. 21m. M.
—			Occul. B.A.C. 1468, im. 9h. 4m. em. 9h. 21m.
—			Occul. ι Tauri, im. 11h. 16m. em. 12h. 31m.
11	19	12	♀ in the descending node
14	19	53	♂ in conj. with the ☽ diff. of dec. 0. 12. N.
15			Clock after the ☉ 14m. 4s.
—			☽ rises 8h. 12m. A.
—			☽ pass mer. 3h. 30m. M.
—			☽ sets 10h. 37m. M.
	19	12	Ceres stationary
16	9	22	☽ in □ or last quarter
17			Mercury, R. A., 15h. 50m. dec. 21. 8. S.
—			Venus, R. A., 16h. 20m. dec. 21. 40. S.
—			Mars, R. A., 8h. 49m. dec. 19. 52. N.
17			Vesta, R. A., 19h. 18m. dec. 24. 47. S.
—			Juno, R. A., 18h. 16m. dec. 13. 49. S.
—			Ceres, R. A., 7h. 10m. dec. 24. 36. N.
—			Pallas, R. A., 3h. 24m. dec. 28. 43. S.
—			Jupiter, R. A., 14h. 23m. dec. 13. 14. S.
—			Saturn, R. A., 1h. 51m. dec. 8. 35. N.
—			Uranus, R. A., 1h. 58m. dec. 11. 31. N.
—			Mercury pass mer. 0h. 7m.
—			Venus pass mer. 0h. 35m.
—			Mars pass mer. 17h. 4m.
—			Jupiter pass mer. 22h. 37m.
—			Saturn pass mer. 10h. 6m.
—			Uranus pass mer. 10h. 12m.
18	2	50	☿ in Aphelion.
19	18	52	Juno in conj. with B. A. C. 6279, diff. of dec. 0. 45. S.
	21		☽ in Perigee
20			Clock after the ☉ 15m. 3s.
—			☽ rises 0h. 25m. M.
—			☽ pass mer. 8h. 7m. M.
—			☽ sets 3h. 34m. A.
21	0	31	♃ in conj. with the ☽ diff. of dec. 4. 2. S.
23	2	6	Ecliptic conj. or ● new moon
	4	57	☿ in conj. with the ☽ diff. of dec. 4. 51. S.
	14	47	♀ in conj. with the ☽ diff. of dec. 3. 19. S.
25			Clock after the ☉ 12m. 55s.
—			☽ rises 10h. 2m. M.
—			☽ pass mer. 2h. 5m. A.
—			☽ sets 6h. 7m. A.
30			Clock after the ☉ 11m. 14s.
—			☽ rises 1h. 13m. A.
—			☽ pass mer. 6h. 14m. A.
—			☽ sets 11h. 23m. A.
	3	27	☽ in □ or first quarter

Eclipses of Jupiter's Satellites are not visible this month,—Jupiter being too near the sun.

J. LEWTHWAITE, Rotherhithe.

THE

LONDON JOURNAL,

AND

REPERTORY

OF

Arts, Sciences, and Manufactures.

CONJOINED SERIES.

No. CCXL.

THE INDUSTRIAL EXHIBITION.

GENERAL REMARKS.

WITH the present number we close our formal review of the Industrial Exhibition; but, as it is an exhaustless subject for comment, we propose, by the aid of some supplementary papers, to render more complete our notice of the industrial resources of the world, as therein illustrated, and thus to retain, as a feature in this Journal, suggestions for the improvement of various branches of our manufactures. It is further proposed, to give, occasionally, retrospective reviews of the progress of practical science in different spheres of labor, and to trace the intimate connection between one branch of industry and another, by shewing the applicability of the same law of nature to various and often numberless uses. By this means it is sought to render the Journal acceptable, not only to those who are pecuniarily interested in the progress of invention, but also to such as value information of this kind from a desire to witness the triumphs of mind over matter.

The manufacture of acids is this month treated of under the head *Raw Materials;* the paper on *Agricultural Implements* includes drilling, dibbling, and broad-cast sowing implements,—leaving manure-distributors, horse-hoes, thrashing-machines, &c., to be afterwards described. Under *Decorative Art,* furniture and wood-carving is noticed; and, according to our promise of last month, we offer some remarks on the probable effects which the Exhibition is calculated to produce upon the industrial world.

RAW MATERIALS.

THE MANUFACTURE OF SULPHURIC ACID.

Referring back to the substances contained amongst the mining and mineral products of the Great Exhibition, we find, in this class, but two objects of British origin still remaining, which, in a manufacturing sense, require notice. These are, sulphur and iron pyrites,—the materials from which sulphuric acid or oil of vitriol, is produced. In speaking of copper pyrites, we took occasion to notice the practice of wasting the sulphurous exhalations generated in the reduction of copper ore; and it certainly is a remarkable circumstance that this should continue, while iron pyrites are coming more and more into use every day for the manufacture of sulphuric acid. The same construction of furnace now employed in the combustion of the one would answer perfectly for the other; and the residuary oxide from copper pyrites would be almost exactly in that condition which copper slag presents prior to assuming the state technically called "regulus," and in which metallic copper, for the first time, makes its appearance in the mass. The roasting of copper ore in such a furnace would, therefore, really expedite and advance the progress of the manufacture of copper, as well as give value to a waste product. It has been shewn, that sanitary motives alone induced the makers of soda to condense their waste muriatic acid in the first instance; though they now discover its worth as a means of manufacturing chloride of lime, and would not again return to the nuisance-creating system if they might. In time, no doubt, the copper smelter will also be compelled to arrest the poisonous fumes now so wantonly evolved; and then he too will find a profit in that which, at present, only injures his neighbour. It is with individual interests as with physical bodies, the largest are the most difficult to move from any established position. Not many years ago, all the sulphuric acid used in this country was made from sulphur alone; and, although scientific men had pointed out iron pyrites as an abundant indigenous source for the generation of this acid, yet no attention whatever was given to this seemingly valueless information. Folly, however, achieved that which wisdom could not reach; and the infatuated cupidity of a Sicilian king compelled our manufacturers to lend a willing ear to the voice of science, and seek at home that which a prohibitive export duty prevented them from obtaining abroad. Their eyes were at length opened, and, too late, the King of Sicily saw his error; for, though the excessive duty on sulphur has since been removed, it has not only failed to put down the use of iron pyrites, but the best informed authorities are decidedly of opinion that this latter will eventually abolish the employment of sulphur, and that Ireland, and not Sicily, will furnish the essential element for the fabrication of nearly all our sulphuric acid. There is, however, one very serious drawback to the general use of iron pyrites for such a purpose; and that is, the presence of arsenic in all the acid thus made. This objection is fatal at present; and the combined agency of mechanical and chemical genius alone can relieve this important manufacture from so great an obstacle. Means have indeed been devised for removing the arsenic from the acid after the formation of the latter; but those acquainted with the practical working of sulphuric acid well know that such a project is futile and impossible on the large scale. There are, in fact, but two modes of dealing with the difficulty,—the one being to prevent the volatilization of the arsenic at all, by mixing the pyrites with some suitable ingredient ere it is thrown into the furnace; and the other, to remove the arsenic from the sulphurous acid before it reaches the chamber of condensation. The first would be the simplest plan; but, in the existing state of science, can scarcely be hoped for. The last, however, is not by any means beyond the scope of perseverance and ingenuity. It must be borne in mind, that, though the arsenic, being in the form of arsenious acid when it leaves the furnace with the sulphurous acid, is in the gaseous state, yet a very trifling reduction of temperature suffices to convert it into a solid powder; in which condition it is merely carried onwards, mechanically, by the current of sulphurous acid; and thus reaches the leaden chamber. The mixture, therefore, resembles that of turbid water; and, bearing this analogy in mind, we shall now proceed to describe the pyritic process of making sulphuric acid,—adding, as we go on, a hint at the proper place for arresting the arsenious fumes, and thus producing a pure and satisfactory acid, equal to that obtained from Sicilian sulphur. The furnace employed for roasting iron pyrites is very peculiar, but essentially consists of an inverted cone, with, of course, a small area of fire-grate, in proportion to the cubical contents of the furnace,—the object of this being, to prevent the surplus passage of air through the furnace, and cause the sublimed sulphur to burn only at the upper part of the mass, where there are two or more holes for the supply of air, duly provided with stoppers, to regulate the combustion above with regard to that below. Thus, at starting, the principal effect of the lower heat is simply to decompose the bisulphuret of iron, and expel one half of its sulphur; and at this stage, the upper openings of the furnace are all requisite, to ensure the combustion of this volatilized sulphur; but, so soon as the bisulphuret of iron has been converted into the proto-sulphuret, then the upper openings are no longer useful, but must be closed, so as to compel the whole of the air to pass through the red-hot protosulphuret, and thus form sulphurous acid and oxide of iron,—the latter of which is ultimately withdrawn as a waste product. An iron pan, containing nitrate of soda, is usually placed in the common flue of a number of these furnaces, to supply nitric oxide gas; and the whole of the volatile products are made to pass through a considerable length of tubing, subjected to the refrigerating effect of the air, so as to cool the gases prior to their introduction into the chamber of condensation.

As the subsequent processes are the same as those adopted with regard to Sicilian sulphur, they will be most conveniently noticed when treating of the employment of that substance; and therefore we now proceed to consider the question of removing from the volatile mixture the arsenical matters which it holds in suspension; for, during the passage of this mixture through the refrigerating tube, above described, the arsenious acid is really solidified; whilst the sulphurous acid, being a permanently elastic gas, suffers but a trifling contraction in its bulk. We requested attention to the case of turbid water as a simile from whence to acquire a correct notion of the kind of mixture passing into the condensing chamber; and this suggests also the means of purification. With turbid water filtration might indeed be resorted to, which is inapplicable to our difficulty; but there is another mode in which water is purified by nature on the large scale, and that is, by deposition, or the attraction of gravitation. For this purpose absolute rest is not necessary; as may be seen on examining the water running into and out of a lake in spring or autumn. It enters foul and muddy; but, at its exit, is clear and pellucid as crystal. This is precisely the object desired with respect to the gaseous products given off from a pyrites furnace, and may be accomplished in precisely the same way. Let a gaseous lake, or large chamber in brickwork, be interposed between the refrigerating tube and the condensation-chamber, through which, of course, the contaminated sulphurous acid would flow, but so slowly as to deposit, like the water in the lake, the mechanical impurities suspended in it, and thus pass pure and undefiled into the leaden chamber, possessing now all the properties and uses of that obtained by the combustion of pure sulphur. The size of this gaseous lake, or arsenical precipitator, as it might be termed, would require adjustment according to the area of the entrance tube and the velocity of the current, but need not, perhaps, be more than one half of the cubical contents of the leaden chamber, especially if the gas entered below and issued from the top.

We are now arrived at the point where the modes of using pyrites and sulphur unite: consequently, it will be necessary to examine the early steps in the employment of this latter. These are quite as simple as the management of a common fire,—for the sulphur is merely thrown into a kind of oven, provided with a door capable of regulating the admission of air; and near to this door, but within the oven, an iron pot, containing nitrate of soda, is placed, the contents of which are in the proportion of about six per cent. of the nitrate to a given amount of sulphur. The sulphur having been once lighted, combustion goes on continuously, and the volatile products, after passing through the refrigerating tube, ultimately enter the condensing chamber; here they are met by a current of steam, which causes the compound of sulphur, nitrogen, and oxygen, to fall to the bottom of the chamber, and, in combining with the water there placed, decomposition ensues, attended with the formation of sulphuric acid and nitric oxide gas; the former of which remains in solution, whilst the latter rises, and, uniting to a fresh portion of sulphurous acid, and to part of the oxygen in the chamber, again falls, and is decomposed as before, until either no more sulphurous acid or oxygen gas remains in the chamber—the latter of which circumstances would imply bad management, and is probably the cause of what is termed "chamber sickness." This condensation process lasts many hours, and sometimes even days are spent in its completion,—the workmen judging of its progress by the colour of the fumes displayed on opening a small door or aperture near the bottom of the chamber: by which they also form an opinion as to the excess or deficiency of nitrous vapour, and apply the appropriate remedy in the combustion furnace. When the water on the floor of the chamber has received a certain amount of sulphuric acid, it ceases to act favorably upon the gaseous mixture, and is therefore withdrawn. For many purposes in the arts, such acid is quite strong enough; and hence, under the name "chamber-acid," it is extensively employed. But, to complete its character as oil of vitriol, this chamber-acid is evaporated, first in leaden vessels, but ultimately in a platinum boiler, set over the naked fire, and provided with a head, or cover, and a syphon-tube, all in platinum: by the syphon-tube, the operator is enabled to draw off the concentrated acid when sufficiently evaporated. A boiler of this kind is kept constantly in action after the fire has been once lighted;—the only cause of stoppage being the necessity for repairs, which are vastly more frequent than might be imagined, considering the imperishable nature of the metal employed in the construction of these boilers. Selenious acid is thought to be the corroding agent, and perhaps correctly, as chlorine is quite out of the question.

MURIATIC ACID.

In treating of soda, we had occasion to comment upon the formation of muriatic acid; and therefore it is unnecessary to enter into the details of that operation again. The purest commercial muriatic acid commonly contains sulphurous acid in considerable quantity, which unfits it for many purposes, and ought therefore to be guarded against; but more than this, when made from sulphuric acid containing arsenic, it is invariably contaminated with that poisonous substance; and hence, those persons who are in the habit of making what is called digestive bread, by an admixture of bicarbonate of soda and muriatic acid with the flour they employ, cannot be too careful in going to none but the most respectable sources for their acid; as an enormous amount of rough muriatic acid is constantly passing through the market positively loaded with arsenious impurity. For the same reason, as chloride of lime is manufactured from the acid, it must be regarded with a cautious eye; as, during the action of such muriatic acid upon peroxide of manganese, a highly volatile chloride of arsenic passes off with the chlorine gas, and is condensed like it by the lime. Since, however, this, in the end, becomes arsenite of lime, a salt almost insoluble in water, the tendency to mischief is greatly diminished. Nevertheless, as in some medico-legal works it is recommended to sprinkle cadaverous exhumations with chloride of lime, the ends of justice may easily be perverted or prevented if due care be not employed to ascertain beforehand that the chloride of lime is pure. Very little indeed of that to be met with in commerce will bear a careful analytical investigation.

NITRIC ACID.

From muriatic to nitric acid the transition is easy, though nitric acid is never obtained as the waste product of any chemical operation. Its manufacture is invariably the primary object of the process by which it is procured. The ordinary method consists in heating together, in a distillatory apparatus, a mixture of nitrate of soda or potash with sulphuric acid. In this way, the sulphuric acid unites with the soda or potash, as the case may be, forming commercial products called salt cake and sal-enixum; whilst the nitric acid combines with the water of the sulphuric acid, and, passing away under the influence of the heat, is condensed in the receiver of the apparatus. A decomposition of this kind is sometimes denominated a simple decomposition; but in reality it is not so, as the transfer of the water completes the cycle of elective affinity. It has been proposed, and even carried into practice, to decompose nitrate of soda by the action of boracic acid, so as to produce biborate of soda, or borax, and thus render the nitric acid a secondary product. The success of this process depends, however, upon a circumstance of a somewhat curious kind. Strong nitric acid is much more volatile than weak acid; and hence it is more easily expelled from its combination with soda in a concentrated than in a dilute form. Now, boracic acid has three atoms of water in its crystallized condition; therefore, if we take two atoms of this acid, we have six atoms of water to unite with the one atom of nitric acid capable of being disengaged from nitrate of soda; whereas this quantity of nitric acid needs at most but two atoms. The secret, therefore, is to dry the boracic acid in the first instance, so as to get rid of the surplus water; and this is easily done at a temperature of 212° Fahr., at which two-thirds of the water readily leave the boracic acid, and thus afford a mono-hydrated compound, two atoms of which contain precisely the amount of water needed for one atom of nitric acid, and also of the boracic acid requisite for the production of the biborate of soda. There are some peculiarities connected with the application of the necessary temperature; but they are of less importance. The biborate of soda is afterwards dissolved in hot water, and crystallized. This process has been patented in France, within the last few years, by a M. Mallet, of Paris. One of the most extensive uses of nitric acid, and for which, indeed, it is chiefly fabricated, is the manufacture of oxalic acid. We are, in some measure, therefore, compelled to pass on to this article; though, in the arrangements of the Crystal Palace, it will be remembered, perhaps, that the order of progression would now bring us to a consideration of tartaric acid,—some beautiful specimens of which were exhibited by Messrs. Pontifex, of Millwall, Poplar, and also by others.

OXALIC ACID.

Oxalic acid may be produced by the action of nitric acid upon most vegetable substances, and especially from those which contain no nitrogen, such as well-washed sawdust, starch, gum, and sugar. The latter is the article generally employed, and possesses many advantages over every other material. Treacle, which is a modification of sugar, also comes within the same range. A very contemptible spirit of exaggeration prevails in respect to the amount of produce attainable by oxalic acid makers from a given weight of sugar. The generality of the statements are absurdly false. One cwt. of good treacle will yield about 116 lbs. of marketable oxalic acid; and the same weight of good brown sugar may be calculated to produce about 140 lbs. of acid. As a general rule, 5 cwts. of saltpetre, or an equivalent of nitrate of soda, with 2½ cwts. of sulphuric acid, will generate sufficient nitric acid to decompose one cwt. of good sugar, and yield, as above, 140 lbs. of fair marketable oxalic acid, free from superfluous moisture. Any hope of improvement seems directed rather to an economy of nitric acid than to an increased production of oxalic acid from a given weight of sugar. The process is carried on either in large wooden vessels or in small earthenware jars dispersed in a water-bath,—each jar having a capacity of about a gallon, or less. The specific gravity of the nitric acid need not be so high when operating on the large scale, in a wooden trough, as when employing the earthenware jars. From 1·200 to 1·270 is the range; and the temperature in neither case should much exceed or fall short of 125° Fahr. The favorable symptoms are a regular and tolerably active evolution of gas, without the appearance of red fumes, and a peculiar odour, which only faintly recalls the smell of nitric oxide. The gases evolved consist, nevertheless, of nitric oxide and carbonic acid; but the influence of this latter gas has a remarkable effect in arresting the affinity of the nitric oxide for oxygen. So long as the carbonic acid is present, the mixture may be mingled with its own bulk of oxygen gas, without any diminution of volume, for several minutes, or the production of red fumes; but the moment a little ammonia vapour is applied, so as to condense the carbonic acid, the whole becomes of a deep orange hue. Herein lies a difficulty connected with the re-conversion of the nitric oxide into nitric acid by the action of atmospheric oxygen; and for the same reason, the employment of these gases in the manufacture of sulphuric acid has not answered the expectations of those who have tried the experiment practically. Carbonic acid would appear to possess not simply a neutral agency in obstructing oxidation, but a negative power of preventing it. How far blowing atmospheric air through the acidulous saccharine solution, during the process of oxalic-acid making, might tend to economize the consumption of nitric acid, we cannot pretend to say; but as the nitric acid really forms the chief item of expense, it is by such expedients that a saving may possibly be effected. When strong nitric acid is boiled upon sugar, in the way recommended in many chemical works, for the production of oxalic acid, a great loss of all the materials ensues; and most of the oxalic acid being peroxidized, passes off as carbonic acid, leaving scarcely as much acid behind as is equivalent to half the weight of the sugar employed. This accounts for the discrepancies which have been published in this branch of manufacture.

Almost the only commercial article made from oxalic acid is the binoxalate of potash or salt of sorrel. This substance results from the decomposition of carbonate of potash by an excess of oxalic acid. The carbonate of potash is first dissolved in hot water, and the oxalic acid added until the effervescence ceases; after which a similar quantity of oxalic acid to that previously employed is thrown in, and the solution is boiled for a few minutes; and then it is set aside to crystallize. The crystals, after being drained and dried, are fit for the market.

TARTARIC ACID.

In consequence of the great variation in the constituents of argol or rough tartar, the manufacture of tartaric acid is not nearly so simple as a first glance at its several processes might lead an inexperienced individual to suppose. The theory of preparing tartaric acid seems indeed a remarkably easy affair; and, provided the materials operated upon were pure or of uniform quality, no kind of manufacture could put on less the appearance of risk or speculation. But too many know, to their cost, with what ready facility the whole profit, and something more, of a large operation, will occasionally ooze off through a variety of unknown channels, and present a sadly defective and truncated return of saleable produce. In fact, money is not unfrequently lost, in this manufacture, by very old and experienced makers. The differences in argol arise from the greater or smaller amount of tartrate of lime combined with the bitartrate of potash; these differences will, in a commercial way, amount to from 5 to 25 or even 30 per cent.; and herein resides a difficulty, requiring more analytical skill and chemical knowledge than is commonly found amongst practical manufacturers. We will suppose that an argol has been purchased, containing, by analysis, 70 per cent. of bitartrate of potash, but also, though unknown to the purchaser, containing 20 per cent. of tartrate of lime. According to the process followed, this argol would be dosed with a definite proportion of chalk or carbonate of lime, so as to produce tartrate of lime with the extra tartaric acid of the supertartrate of potash. This tartrate of lime, being insoluble, would fall and mingle with the 20 per cent. already existing; but as, in practice, the quantity of sulphuric acid employed for subsequent decomposition of this tartrate of lime, is proportioned to the amount of chalk originally employed, it follows that the tartrate of lime naturally present in the argol, is left undecomposed, and comes to be regarded as sulphate of lime, to the great loss of the manufacturer, who probably finds his more intelligent neighbour able to buy as he buys, and yet capable of underselling him in the open market. To illustrate the full bearing of this and other interesting points in the fabrication of tartaric acid, it will be better to enter into a condensed description of the whole process, taken on the assumption that pure bitartrate of potash is the raw material to be used in the manufacture. Having weighed out a given proportion of this substance, it is to be thrown into a leaden boiler, provided with a stirring apparatus; and the whole has sometimes a closely-fitting cover, provided with a pipe for carrying off and utilizing the carbonic acid gas, generated, as we shall see, during the first operation. The bitartrate of potash having been introduced into this vessel, water is then added, and a quantity of dried chalk, in the ratio of about one part of dry chalk to four of bitartrate of potash, put in by degrees. After boiling and stirring for some time, the effervescence due to the carbonic acid, arising from the decomposition of the chalk, ceases; and then the tartrate of lime is to be allowed to subside, that the clear solution of tartrate of potash may be tested with litmus, to demonstrate the non-existence of bitartrate of potash in the fluid. This being satisfactory, a quantity of finely-powdered sulphate of lime is now thrown in, equal to one and three-quarter times the weight of the dried chalk first employed, or rather better than $\frac{2}{5}$ths of the bitartrate of potash. This mixture must be boiled for a considerable time, and assiduously stirred, until a little of the clear liquor, when hot, affords no precipitate on the addition of a strong solution of nitrate of lime. The decomposition is now complete, and the whole of the tartaric acid will be found united to the lime as an insoluble powder (tartrate of lime); whilst the potash, in the state of sulphate, exists in solution, and may be procured by evaporating the clear liquor. After the insoluble tartrate of lime has been two or three times washed with warm water, it is to be decomposed by a slight excess of diluted sulphuric acid, made by mixing together oil of vitriol, equal to 2¼ times the weight of the chalk used, with 10 times its bulk of water. In this way sulphate of lime is formed, which is set aside for a subsequent operation, leaving the tartaric acid, with a trifling excess of sulphuric acid, in the clear solution. This solution, when crude tartar has been employed, has generally a brown or reddish-yellow color, and requires to be digested for some hours upon animal charcoal, to purify and bleach it. When this is effected, it is carefully evaporated on a water-bath, or by steam-heat, and, after proper concentration, run out into large cylindrical leaden coolers to crystallize. A second solution, digestion on animal charcoal, and recrystallization, are generally needed to render the acid white enough for the market. From the above it will be seen that, unless the manufacturer is not only aware of the surplus tartrate of lime present in the rough tartar he buys, but has also a tolerably correct idea of its quantity, he runs a risk, almost amounting to a certainty, of leaving undecomposed tartrate of lime in his sulphate of lime; and as this latter is in great part a waste product, the two pass away from the works, under one name, as mere refuse. But there is also an important consideration connected with the evaporation of solutions of tartaric acid. This is generally, and, indeed, we might say invariably, done in contact with atmospheric air,—the solution meanwhile containing a perceptible excess of sulphuric acid; but, under such treatment, tartaric acid undergoes decomposition almost as readily as sugar; and therefore, like sugar, it ought to be operated upon *in vacuo*, or, at least, in a vessel similar to a vacuum-pan, but lined with lead, to prevent cupreous contamination. In this way, and by knowing the exact composition of the rough tartar used in every instance, the greatest certainty might ultimately be secured in this delicate manufacture, instead of the conflicting and paradoxical results which now annoy, and too frequently dishearten, the practical operator.

CITRIC ACID.

The manufacture of citric acid so closely resembles that of tartaric acid, that the makers of one commonly fabricate the other. The raw material in this case is pretty generally a black fluid, like thin treacle, which comes from Sicily, and is obtained by inspissating the expressed juice of the lemon,—the rind having previously been removed from the lemon for the sake of its essential oil. This black juice is impure citric acid, and requires to be treated with chalk, as practised with respect to the first operation on tartar; by which means, an insoluble citrate of lime is formed; and this, after being well washed with cold water, is decomposed by sulphuric acid; and the solution, after undergoing the action of animal charcoal and proper evaporation, yields brownish crystals on cooling. These are re-dissolved, decolored, and crystallized three or four times, ere they can be sent into the market: for citric acid is more tenacious of coloring matter than most of the other vegetable acids. At Nice, and in the South of France, a portion of chloride of lime is digested upon the citrate of lime, to bleach it prior to decomposition by sulphuric acid. For this purpose, the washed citrate is exposed, in shallow vessels, to the action of the sun's rays, covered by a weak solution of chloride of lime. In a few hours decoloration ensues; and it is, moreover, stated, that the mucilage which hangs about the citrate of lime, and impedes the subsequent crystallization of the acid, is, in this way, destroyed, and the number of re-crystallizations requisite to give a saleable aspect to the citric acid thereby diminished. The use of chloride of lime for this purpose seems unknown, or, at least, is not practised in England. Of the samples of citric acid shewn in the Great Exhibition, those from Howards and Kent, of Stratford, Pontifex and Wood, of Millwall, and J. Huskisson, of Gray's-inn-road, were extremely beautiful; and, in respect to size and crystalline form, surpassed anything exhibited in the French, Prussian, or Italian departments.

PHOSPHORIC ACID.

In the British portion of the building there was one acid missing, which existed in great abundance and perfection amongst the German chemical preparations. We allude to the glacial phosphoric acid, of which that displayed by the Royal Prussian chemical manufactory at Schöenebeck can scarcely be too highly spoken of. From some unknown cause this acid has not attracted the attention which it deserves in the arts and manufactures of this country. For many of the wants of the dyer, the calico printer, the enameller, and even in the purification of some oils and fats, the glacial phosphoric acid has much to recommend it over any of the common acids at present in use. Nor need its price prove an insuperable obstacle to its introduction as a practical agent. Finely-ground bone-ash, digested with a due proportion of oxalic acid and water, readily yields a solution of phosphoric acid, which requires only to be evaporated in a proper vessel to furnish at once this useful article. Unlike sulphuric and other strong acids, it is not decomposed by organic matter; and might hence be employed with great advantage in the precipitation of carmine and other delicate vegetable colors, as well as for more general purposes. Some experiments have also shewn that, combined with alumina and a little boracic acid, it is capable of producing a glaze for earthenware of extreme beauty and durability, in addition to its perfectly innocuous character and power of improving the colors imparted by most metallic oxides when applied to earthenware.

Our remarks on the manufacture of acetic acid, which forms more properly a sequel to the operations of brewing and distilling, we must reserve for the present, as this subject will be best treated in the regular order of its associations;—an opportunity of considering which, will be provided in a supplementary series of papers.

AGRICULTURAL IMPLEMENTS.

SOWING SEED.

The operation of depositing seed in the earth is effected by "broad-cast sowing," by "drilling," or by "dibbling."

Broad-cast sowing (the most ancient mode) is performed by strewing the seed by hand over the ground, which has been previously ploughed and harrowed; and a set of light harrows is then drawn over the field to rake in the seed. There are some machines for sowing broad-cast; but these are specially designed for sowing grass seeds, and are rarely employed for depositing grain.

Drilling is strictly a mechanical operation, performed by machines which deposit the grain or seed in small parallel drills or furrows, formed by coulters or shares, carried by the machines; and the grain or seed, so deposited, is covered with earth, either by apparatus attached to the drilling machine, or by the subsequent use of harrows, as before stated. Drilling machines in general deliver the grain, or grain and manure, in continuous streams; but there are some which deposit it in detached quantities at equal distances apart, in like manner to dibbling; and machines have likewise been devised which will not only form drills or furrows, but also make dibble-holes therein, at suitable distances, and deposit the grain and manure in such holes.

Dibbling consists in making small holes in the ground, at short distances apart, for the reception of grain or seeds: such holes have been most commonly produced by a man or boy forcing a stick or pointed tool into the earth; and the introduction of wheat, beans, or other seed, has been an after process; but of late years some improved tools have been invented, which make the hole and deposit the seed at one operation. Tools of this nature have also been combined to form machines, to be worked by manual labor or drawn by horses, for the purpose of making and filling several rows of holes simultaneously.

In treating of the implements of this class which the Great Exhibition contained, we shall first notice the drilling machines, then the dibbling implements, and lastly, the machines for sowing seed broad-cast.

DRILLING MACHINES.

The drilling machine in general presents to the eye of the uninitiated the appearance of a very complex piece of mechanism; but this is chiefly owing to the requisite multiplication of like parts, in order to form, simultaneously, several parallel channels or furrows in the earth and deposit seed or seed and manure therein; for a few words will serve to explain the principle of construction of the drill. The drill must necessarily possess means of producing the channels or furrows for the reception of the seed, and of introducing the seed into the same. Each channel is formed by means of a small share or coulter (somewhat like a V in plan), affixed to a lever, which is hinged at one end to a horizontal rod, extending across the front of the machine; and at the hind end the lever is weighted, and is suspended from the back of the machine by a chain, which thus regulates the depth that the share or coulter enters the soil. The seed is contained in a hopper at the upper part of the machine; and in this hopper a horizontal shaft extends from one end to the other, carrying several wheels, with small spoons or cups projecting laterally from them. The cups of each wheel, as the shaft rotates, severally take up a portion of seed and deliver into a funnel-shaped pipe, whence it descends through other tin pipes, funnels, or conductors, hanging loosely, one under the other, and passes through an opening in the back of the coulter into the channel or furrow. When manure is to be deposited, as well as seed, the machine is furnished with another receptacle or hopper, from which the manure descends, through suitable conductors, to an opening in the back of another coulter (affixed to each lever in advance of the coulter first mentioned), and then falls into the furrow. In the manure hopper, there is a shaft, provided with arms or stirrers, which project the manure into the mouths of the pipes that convey it to the ground; and this shaft, as well as that in the seed hopper, is caused to rotate by gearing connected with one of the travelling wheels of the machine. In one-row drills the lever is dispensed with, and the frame of the implement forms the direct support for the coulter or coulters.

In the award to Messrs Garrett and Son of a Council medal, three implements for sowing seed are included: viz., a general-purpose drill, a four-row turnip drill on the flat, and an improved hand-barrow drill for grass seeds. The general-purpose drill can be used for depositing corn and all kinds of seeds in the earth, either with or without manure, in any desired quantities, and in rows at any required distance apart. The corn and seeds may be delivered down the same conductor with the manure, and discharged at the back of the same coulter; or, preferably, they may be delivered, through separate conductors, to two coulters, one behind the other. In the latter case, the first, or manure coulter, works about ten or twelve inches in advance of the seed coulter, and penetrates two or three inches deeper into the soil; so that the manure is buried deeper than the seed, and, by means of a small fork or rake, between the two coulters, it is covered with earth before the second coulter deposits the seed upon it. The levers that carry the coulters are capable of lateral adjustment to regulate the distance between the furrows. The two coulters have been commonly affixed to the same lever, which rendered them incapable of an independent action; but this inconvenience is remedied by affixing the seed coulter to a small lever, which is jointed, at the fore end, to the lever that carries the manure coulter, and is capable of rising and falling independently of the other: by this means, when the levers are suitably weighted, the seed and manure will be deposited at any desired depth, one below the other, although the land may be of a very uneven character. The seed box is made separate from the manure box, to allow of the manure apparatus being removed when not required to be used in conjunction with the seed-depositing apparatus. The manure-box is furnished with an extra stirrer or agitator, for stirring the upper part of its contents, and preventing the manure from adhering in masses; and the box is divided into two compartments, having each a separate slide, which is regulated, so as to lessen or increase the amount of manure delivered from either compartment, without stopping the drill. This is particularly useful on hilly lands, where some portions are richer than others, from the best soil having been washed into the valleys.

In order that the coulters may be guided so as to deposit the grain in rows parallel to those previously made, the drill is fitted with a "swing steerage:" that is to say, the bar to which the coulter levers are jointed is suspended from the frame of the machine by descending rods, which admit of the bar being moved endwise across the drill, in either direction; and it is moved, as required, by the attendant at the back of the machine turning a handle, fixed on the hind end of a rod, which is cranked at the fore end, and connected to the coulter-lever bar. The swing steerage answers when the drill covers each stetch of land in two journeys; but for broad work, a "fore-carriage steerage" is adopted, which renders an additional attendant necessary. The fore-carriage consists of a transverse frame, connected to the front part of the drill framing by an upright bolt or pin, around which it is capable of turning freely; this frame, to which the horse is yoked, is supported by a wheel at each end, of different diameters—the near side one being the smaller; and to the top of the frame is attached a horizontal lever-handle, by which the attendant, who walks on the near side of the machine, is enabled to turn the fore-carriage in either direction, so as to guide the drilling machine correctly, and cause the seed to be deposited in rows parallel to the preceding rows. With the swing steerage, the coulters are moved laterally, in curved lines, and, consequently, they do not penetrate the earth to a uniform depth. This inconvenience Messrs. Garrett have lately remedied by their patent "parallel steerage," which is applicable both to drills and horse hoes. In this arrangement, the bar to which the coulter levers are connected, instead of being suspended by jointed rods from the stationary framing, is attached to a parallel frame, capable of sliding to and fro, horizontally, between antifriction rollers. This frame is connected, by a short rod, with a crank-arm on the end of a long horizontal rod, extending to the back of the machine, and carrying a pair of handles, by means of which the attendant can traverse the parallel frame to the right or left, and, consequently, move the coulters in either direction horizontally.

Most of the preceding remarks apply to the turnip drill, which is intended to deposit two, three, or four rows of turnip or other seed, together with compost or artificial manures. It is provided with a separate seed-box for each row; and the several boxes are fitted to a horizontal bar, whereon they may be shifted to suit various intervals between the rows. Each box is divided into two compartments, one larger than the other; so that, when drilling beet and turnip seeds together, sufficient of each to last an equal time may be put into the boxes at once.

The hand-barrow drill for grass seeds will be noticed when treating of machines for sowing seeds broad-cast.

The award of a Council medal to Messrs. Hornsby & Son, includes, among other agricultural implements, a corn and seed drill, a two-row turnip drill on the ridge, and a drop drill. In the corn and seed drill several novelties were observable. The seed, instead of descending through a series of tin funnels or pipes, suspended one below the other, as usual, is conducted to the ground by a continuous tube of vulcanized India-rubber: by which means it is protected from the effects of wind or rain, and is more regularly delivered than by the ordinary plan. To ensure a uniform delivery of seed from the box, all the slides, which regulate the supply from the pigeon-holes, are caused to move simultaneously, by being attached to a light bar, which is raised and lowered by racks and pinions; and thereby the feed can be increased or diminished at pleasure, without stopping the machine. This drill is fitted with ten coulters, arranged in two rows, so that the alternate ones work a short distance before the others, as is usual in machines with a like number of coulters. In the ordinary drills, however, the coulter levers are all jointed to the same transverse bar; and therefore, as the levers are all of the same length, the weights at their hind ends do not exert an equal pressure upon the front and back coulters. According to Messrs. Hornsby's arrangement, there are two transverse bars, one for the levers that carry the front row of coulters, and the other for the levers of the back row; and, as all the coulters are set at the same distance from their axis of motion, the weights on each coulter lever will act uniformly, and cause the coulters to penetrate the soil to a uniform depth. The drill is fitted with an improved fore-carriage steerage, which enables the attendant to regulate the course of the machine more effectually than when the fore-carriage is turned by means of a lever-handle on the top. In this case, a small rack-bar is fastened to the upper part of such carriage, on the near side, and projects backward to gear into a pinion on the fore part of the drill frame; the pinion is furnished with a handle, by turning which, the attendant can move the near side of the fore-carriage backward or forward; and the increased leverage, thus obtained, enables him to prevent the fore-carriage swerving when the wheels pass over a large clod or stone. Messrs. Hornsby have also devised an improved swing steerage, worked by a handle on the end of a rod or shaft, extending to the front of the drill frame, and carrying a pinion or toothed sector, which gears into a rack on the bar to which the coulter levers are jointed. To render corn and seed drills suitable for working on the side of a hill, the seed-box is mounted at the centre on a horizontal axis; and, by means of a screw at one end, the box is caused to turn on its axis in either direction, while the drill is moving onwards: the box can thereby be kept perfectly horizontal when the drill is travelling on the side of a hill which inclines in the ratio of one foot in six; and, consequently, the delivery of the grain or seed will be as regular as if the machine was working on level ground.

In Messrs. Hornsby's drop drills, each coulter is furnished with a small revolving hollow wheel or drum, for depositing the seed and manure. From the inner surface of the wheel six angular pieces project towards the centre, so as to form a like number of recesses for the reception of the seed and manure, which enter through an opening at the centre of the case. Those portions of the periphery of the wheel which constitute the bottoms of the several recesses are hinged on one side, so as to be capable of opening outwards; but they are kept closed, until they have passed their lowest position, by a spring on the back of each bearing against a semicircular guide; and, as each spring leaves the extremity of the guide, its door opens, and permits the seed and manure to fall into the channel or furrow produced by the coulter. When it is desired to deposit the manure first, and to cover it with a small quantity of earth, before the seed is delivered, the seed-coulter is attached to a small lever, which is jointed to the large lever that carries the manure-coulter, in like manner to the levers of Garrett's "general-purpose drill;" and the earth is drawn over the manure by means of a curved bar or rake.

A ribbing corn drill is included in the award of a Council medal to Mr. Busby, of Newton-le-Willows. This is a simple and cheap implement, invented by the Rev. W. Wharton, of Barningham, Yorkshire, for the use of small farmers. It is specially adapted for strong land, where it is often a difficult matter to make the coulters of an ordinary drill penetrate the soil to a sufficient depth; and even, when this is accomplished by the use of a press-bar, the draught of the implement is so much increased as to render an extra horse necessary. The ribbing plough is frequently employed in these cases, in order to ensure a good plant of wheat; but the operation is a slow one, and the seed must necessarily be sown by hand. These disadvantages are remedied by the drill under notice, which combines the mode of opening the seed furrows, peculiar to ribbing ploughs, with the plan of delivering seed adopted in corn drills. The machine consists of a stout wooden frame, running on a pair of hind wheels and a large swivel fore wheel. The front bar of the frame carries a horizontal shaft, whereon are the sockets of six curved bars, which carry a corresponding number of ribbing ploughs; these bars are connected by chains with another horizontal shaft above the front bar, having a long lever projecting therefrom to the back of the machine; and, by means of this lever, the shaft can be turned when it is desired to raise the ribbing ploughs. A seed-box is mounted on the frame, and furnished with suitable cup-wheels, &c., for delivering the seed, which descends through inclined pipes into the furrows opened by the ribbing ploughs. The inclination of the seed-box, when going up or down hill, is adjusted by similar means to those ordinarily employed in corn drills: *i. e.*, by turning a screw-rod, connected by a swivel-joint to the back bar of the frame, and working in a swivel-nut on the under side of the seed-box. When it is required to change the toothed wheel on the axle of the seed-wheels for one of a different size (so as to increase or diminish the speed), the axle can be raised or lowered by turning a screw-bolt, which passes through a fixed nut, and carries a metal loop that forms the bearing of the axle; and this end of the axle can also be raised by a lever, in order to throw the wheel out of gear when turning at the end of a stetch. This plan of altering the height of the axle of the seed-wheels, in order to change the size of the speed-wheel, appears to be preferable to that of raising or lowering the seed-box, as commonly practised. The steerage is effected by means of a long iron bar, affixed to the stem that carries the axis of the swivel fore wheel, and extending to the back of the machine, where a lever-handle is jointed to it at right angles.

Messrs. Ransome and May obtained a prize medal for their drop drill, by which corn or seed is deposited in regular quantities, at equal distances apart (as when dibbling by hand), in the seed-furrows. The coulters are solid curved or quadrant-shaped pieces, bearing some resemblance, in the transverse section, to the shape of a pear; and the front edge thereof is sufficiently sharp or angular to form the furrows or seams with facility. Above and behind each coulter there is a seed depositor, which acts independently of the coulter, and is so contrived that the delivery of seed ceases when the machine stops. The seed depositor consists, in the first place, of a small semi-cylindrical block, which is caused to oscillate in a close-fitting cylindrical case, connected to the under part of a small seed-hopper. The block is placed with the convex side uppermost; in which side two holes are formed, at right angles to each other, for receiving and measuring the seed; and as each hole is brought, in its turn, by the oscillation of the block, beneath the discharge opening of the hopper, it is filled with seed, and then moves back, until it reaches an enlarged part of its case, where the seed falls into a delivery-spout or pipe. There are two delivery spouts, the discharge apertures of which open towards each other, and are furnished with a vibrating flap or valve, that alternately closes one or other of the apertures; and the motions of the valve are so regulated that it will close the discharge aperture of the spout which is at the moment receiving the seed; so that the whole of the seed will collect at the aperture behind the valve, and fall into the furrow or seam immediately that the valve is moved away for the purpose of closing the aperture of the other spout, into which the next measure of seed is about to be introduced.

A two-horse corn and seed drill, exhibited by Messrs. Hensman and Son, was included in the award to them of a prize medal. The horses are connected to the front bar by whippletrees and chains, instead of shafts, as usual; and by means of long bars or handles, which project from the back of the machine, the attendant can steer it with great exactness. The axletrees are made to slide, in order that the wheels may be set at any desired distance apart. The seed-box is self-acting, and will maintain a horizontal position on hilly land, so as to deposit the corn equally up and down hill, without the necessity of readjusting its position. Each coulter is made with a long blade or point, projecting in front thereof, and curving upwards, so as to penetrate the soil with facility, and form a seam or seed-furrow.

Messrs. Reeves, of Bratton, Wiltshire, obtained a prize medal for a liquid manure drop drill and a liquid manure distributing cart, the invention of Mr. Chandler, of Aldbourne, Berkshire, but improved and manufactured by the exhibitors. The drill is designed to deposit seed in the earth, and, at the same time, apply liquid manure thereto. The seed-depositing apparatus is of the ordinary kind, and is applied to the back part of the machine, at the top of the chamber that contains the liquid manure. The framing of the machine is similar to an ordinary cart frame, and is furnished with a pair of travelling wheels and a pair of shafts. The manure chamber is made with the front part upright, the back inclined, and the bottom semicircular; and it is supported by a pivot or axle on each side, so as to admit of being turned partly over, by means of suitable mechanism, in order to empty it completely. The chamber contains two horizontal shafts, one at the upper and the other at the lower part thereof; on each shaft are fixed as many chain-pulleys as there are coulters attached to the machine; and around every pair of pulleys an endless chain passes, carrying several buckets. The shafts, and, consequently, the endless chains, are set in motion by gearing from one of the running wheels; the buckets are thereby made to descend into the liquid manure, and take up a supply thereof; and they then ascend to the upper part of the chamber, and discharge their contents into large tin funnels, or conductors, connected with the coulter. The seed is delivered from the seed-box, by the usual means, into small funnels, or conductors, and discharged into the large funnels, whence it descends, with the liquid manure, into the furrows or channels formed by the coulters.

A hand drop drill and a horse drop drill, invented by Dr. Newington, of Knole, Sussex, were exhibited by Messrs. Dufaur and Co., of Red Lion Square. The hand drill consists of a light frame, mounted on a pair of wheels, and furnished with a handle, by which it is drawn over the ground. Three coulters are secured to the frame, beneath a corresponding number of small seed-boxes. In the bottom of each seed-box there is an opening, from which the seed is conducted by two funnels into the cleft or hollow of the coulter; over each opening is placed a horizontal plate, having two holes or seed-recesses in it; and this plate is caused to oscillate upon a centre-pin, so as to bring each hole alternately over the opening in the bottom of the seed-box, in order that its contents may drop through the spout into the seed-furrow,—there being a stationary guard, with a row of bristles on each side of it, over the opening, to sweep away any surplus seed from the seed-recesses, and ensure the delivery of a regular quantity. The oscillating motions of the several plates are produced by a tail-piece or projection on each entering a slot in a plate affixed to a bar, having an alternating backward and forward motion. The bar is traversed by two rotating crown-wheels, having triangular or wedge-shaped teeth, which alternately act on opposite ends of the bar, and slide it to and fro; and, between the teeth of the wheels, there are flat spaces, which permit the bar and oscillating plates to remain stationary while the seed is dropping from the holes or recesses. The crown-wheels are affixed to the axle of the running-wheels; but the latter wheels turn freely on such axle, when the machine is travelling from place to place; and, when it is desired to deposit the seed, the running-wheels are connected to the crown-wheels by clutch-boxes. By means of the arrangement described, the seed is deposited in small quantities, at regular distances apart, in the furrows; and it is covered with earth by two curved blades, affixed to the back of each coulter.

The horse drill, or seed and manure depositor, in addition to the above-described seed-depositing apparatus, is fitted with a hopper, and parts connected therewith, for delivering manure. The hopper extends from one end of the frame to the other; and, in the bottom, there is a longitudinal opening, the size of which is adjusted by a regulating plate, according to the quantity of manure required to be delivered. Over the opening is placed a horizontal plate or strip of metal (having its lower edge serrated), affixed to the side of a bar, which is connected, by arms, to the sliding-bar before mentioned; and, therefore, as the latter bar slides, the platé with the serrated edge will move to and fro, and cause the manure to flow, in a regular and continuous stream, from the longitudinal opening. Small wires are attached to the first-named bar, for the purpose of keeping the manure from forming into masses.

Mr. Sheriff, of West Barnes, near Dunbar, exhibited an improved corn and seed drop drill, provided with an apparatus for indicating the distance it had traversed. This apparatus consists of a train of wheelwork, enclosed in a box, and furnished with two index dials and pointers;—the wheelwork being set in motion by means of an endless band from a small pulley, affixed to one of the travelling wheels of the drill. The coulter levers (six in number) are connected together in pairs by a cross-bar; and each pair is weighted by a weight suspended from the cross-bar. At the back of the machine there are two lever handles, for raising the coulter levers; and each handle is connected, by chains, with two pairs of levers: consequently, by lifting either handle, the four levers which are nearest to that handle will be raised. Through the seed-box a spindle or shaft extends, carrying several wheels or bosses with radial blades, which, as the shaft rotates, push the seed into the discharge apertures in the bottom of the box. The size of these apertures is regulated by a slide, moved by a lever; and to this lever is attached a pointer, which travels over a graduated plate, and indicates the changes in the adjustment of the apertures. Beneath the seed-box there is a horizontal wooden bar, formed with a corresponding number of holes, which are fitted with pipes, to conduct the seed into the furrows.

In a drop drill, exhibited by Mr. Revis, of Stockwell, the pipes that conduct the seed from the seed-box into the seams or furrows are closed at the bottom, and divided longitudinally into two pieces, one of which is fixed, and the other is raised at intervals, so as to permit a portion of seed to escape [as in Newberry's dibble, hereafter described]. The earth is drawn over the seed by a set of double-wing coulters, standing in a reverse position to those which form the furrows.

Lieut. Col. Marshall, of Craigellachie, Scotland, contributed a "cereal seed-planting and simultaneously-operating machine, constructed to shew the advantage of thin seeding." This apparatus is designed to sow grain and grass-seed at one operation. Furrows are formed by a row of coulters in the usual manner; and the grain is deposited therein by funnels or conductors, which receive it from the recesses of suitable seed-wheels,—the quantity that enters into such recesses, as the wheel rotates, being regulated by a fixed brush. To the back of each coulter is hinged a lozenge-shaped frame, which travels on the soil and covers in the grain. Behind these, the machine carries a seed-trough, furnished with rotary brushes, by which the seed is caused to issue through circular perforated plates, and fall on to the earth in the spaces between the furrows or drills. At the back of the machine there are several rollers, which revolve on the same axis, and complete the operation.

M. Claes, of Lembecq, Belgium, obtained a prize medal for his corn and seed drill. This implement is supported by a pair of hind wheels and a single swivel fore wheel,—the stem of the latter carrying the hook for the whippletrees; and it is furnished with a pair of handles at the back, for the purpose of guiding it. The seed-box is a trough of a triangular form in the cross section, having at the bottom a horizontal spindle, which carries a small wheel or boss, with radial vanes upon it, opposite each of the discharge apertures of the trough. As the spindle revolves, the vanes eject the seed through the apertures; and these can be adjusted to the proper size by a slide, in order to regulate the quantity delivered, without stopping the drill. From the apertures, the seed falls into the seams or furrows through pipes or conductors, which terminate at the hind part of a series of coulters, affixed in an inclined position to the front bar of the drill. The seeds are covered with earth by small rakes that follow the coulters. These rakes each consist of a stem with two small blades or wings at the lower part; and they are attached to weighted levers, which are jointed to a bar at the back of the drill, so as to work independently of each other.

The Prussian department contained a model of a drill, consisting of a long seed-box or trough, mounted on a pair of wheels, and fitted with shafts for a horse; at the back a pair of handles was fixed; and, beneath the seed-box, was a bar carrying a row of coulters, with arms projecting from the stems, and furnished with ring ends, to receive the lower extremities of the seed-conductors.

A seed-sowing machine, which seems to occupy an intermediate place between a drop drill and a broad-cast sowing machine, was exhibited by M. Crespel-Delisse, of Arras, France. This machine consists of a stout wooden frame, running on four wheels (two large fore wheels and two small hind wheels), guided by a pair of handles behind, and drawn by whippletrees from the front bar. On each side of the frame is a seed-box or hopper, which communicate, through the ends, with the interior of a horizontal cylinder, rotated by the onward progress of the machine. Around this cylinder seven rings of holes are pierced, at equal distances apart. and covered with brass bands, similarly pierced, and capable of sliding round the cylinder. As the cylinder rotates, the seeds, introduced into it from the hoppers, drop from these holes into the divisions of a trough beneath; and thence pass down pipes to the earth. At the back of the machine eight inclined wooden rods are affixed to a cross-bar, for the purpose of acting in the manner of harrow teeth, and covering the seed with earth.

The preceding machines are intended to deposit several rows of seed at the same time. We have now to speak of those implements of this class which are employed for depositing a single row of seed,—including one-row drills and ploughs, furnished with apparatus for delivering seed into the furrows formed by them.

Messrs. Deane, Dray, and Deane, exhibited a one-row turnip drill, consisting of a small wooden frame, having a pair of shafts for a horse, fitted with handles at the back, and running on a pair of wheels. It carries a large and a small coulter, having suitable manure and seed conductors connected thereto: the large one opens the ground and delivers the manure, and the small one subsequently deposits the seed thereon. Motion is communicated in the usual way, by toothed wheels, from the axle of the running wheels to the spindles that carry the cup-wheels for delivering the manure and seed from their respective hoppers. The supply of manure is increased or diminished by inclining the hopper backward or forward, and by moving a slide more or less over the discharge opening at the bottom thereof. The quantity of seed delivered can be altered by changing the cup-wheel. The delivery of the manure and seed is stopped, when the drill is turning, or when travelling from one field to another, by moving a lever at the side of the apparatus, and thereby shifting a coupling-box that connects the axle with the toothed wheels which give motion to the cup-wheels.

Messrs. Cottam and Hallen, of Winsley-street, contributed a one-row drill of the like kind. At the front it carries a roller, with a concave surface, to form a ridge, in which the large coulter opens a furrow and delivers the manure; a two-pronged closer or rake draws the earth over the manure; then the small coulter deposits the seed in the earth above the manure; and, lastly, a plain cylindrical roller follows the seed-coulter to press down the soil.

Mr. Padwick, of Hayling Island, Hampshire, contributed a hand drill for depositing garden and other seeds, adapted for use in spots where seed has failed, for allotments, or for rough uneven land. It consists of a small seed-box, affixed to the lower end of a long rod, and mounted on a wheel, the axle of which projects through the seed-box and carries a cup-wheel; this wheel delivers the seed into a funnel, forming part of a hollow coulter; which, as the implement is drawn along, opens a furrow, and at the same time deposits seed therein.

In the American department, Messrs. Allen and Co., of New York, exhibited a one-row hand drill, or seed-sower. This implement is a light barrow-frame, fitted with a large wheel and a pair of handles, and carrying a seed-hopper; at the bottom of the hopper there is a small wheel, with recesses in its periphery, working against a brush on each side, and dropping the seed, as it rotates, down conductors into the furrow formed by a coulter which is fixed beneath the hopper;

and then the earth is pressed on to the seed by a small roller following the coulter. Motion is communicated from the running wheel to the seed wheel by an inclined spindle, having, at the upper end, a fixed bevil-pinion, gearing into a pinion on the axle of the seed wheel; at the lower end it carries a spur-pinion, which is capable of sliding up and down the spindle, so as to gear into any one of five concentric rows of teeth on the side of a disc affixed to the running wheel; and by this means, the number of revolutions which the seed wheel makes, for each one of the running wheel, can be readily increased or diminished.

Mr. Hayward, of Crewkerne, Somersetshire, contributed a plough, with drilling apparatus attached, suitable for sowing corn and turnip seed, particularly in a dry season. This plough, at the back, carries a hopper, containing two seed wheels, from which the seed descends, through pendent conductors, into the furrows formed by two small coulters attached to the frame of the plough. An antifriction wheel, connected to the hind end of the beam, runs on the earth behind the coulters; and from the axle of this wheel motion is transmitted, by toothed wheels, to the axle of the seed wheels.

The French department contained two implements of this kind. The plough of one is fitted with a double-wing share and double mould-board; on the beam is a seed hopper, furnished with a seed wheel, which discharges the seed, through a pipe, into the furrow formed by the plough—an antifriction wheel travelling on the soil, between the hind ends of the double mould-board, and giving motion, by an endless band, to the axis of the seed wheel. The other implement is a double-furrow plough, having two straight wooden beams, supported at the fore end by a two-wheeled carriage. Behind the mould-board of each plough a hopper is affixed to the beam, to contain seed, which is discharged into the furrow by the revolution of a small notched roller—the rollers being caused to revolve by an endless chain, from a pulley on the axle of each fore-carriage wheel, passing around a pulley on the spindle of the corresponding roller.

DIBBLING IMPLEMENTS.

Dibbling implements may be divided into two classes,—the reciprocating and the rotary: the reciprocating dibbles are straight pointed tools, which are alternately forced down into the earth and raised therefrom; and, in the rotary dibbles, the points that form the holes are attached to discs or wheels, by the rotation of which they are caused to penetrate and leave the soil. Reciprocating dibbles are made in the form of single tools, to be worked by hand, and also as machines, with several dibbling instruments, to be actuated by manual labor or horse power. Rotary dibbles necessarily assume the form of rather complicated machines, and are kept in motion either by men or horses. Specimens of all these were to be found in the agricultural department of the Exhibition; and we shall therefore first describe the reciprocating dibbles, and then notice the rotary ones.

Mr. Nicholls, of Elizabeth-street, Eaton-square, exhibited a corn dibbling apparatus, consisting of four dibbles, attached to a frame by an arrangement of levers, in such manner that, by taking hold of a pair of handles at the back of the frame, the apparatus can be rocked forward upon its lever-legs, and caused to progress by a series of intermittent steps or jumps,—the length of such steps regulating the distance between the rows of corn. The arrangements for supplying seed and preventing the opening in the dibbles, through which the seed escapes into the earth, from being choked up, are of an ingenious character. Each dibble consists of an upright tube, fitted at the lower end with a conical nozzle, which is moveable, and is secured to the tube by a spring-catch; and therefore, if a stone or other hard substance should become fixed in the opening of the nozzle, it can readily be disengaged from the tube. Within the tube is a central rod, having its lower end enlarged to fit the opening of the nozzle; this rod is caused to work up and down by being connected with the lever action; and, simultaneous with such movements, a bent arm or seed-feeder is caused to oscillate upon a horizontal axis. The seed-box is divided into two compartments, from one of which the seed is admitted into the other through an opening adjusted by a slide, so as to regulate the quantity supplied. To the end of the seed-feeder is screwed a small cup, of a size suitable for receiving one or more seeds; this cup, when the arm descends into its lowest position, is brought beneath the surface of the seed in the second compartment of the seed-box, and receives a supply thereof; and, on the arm rising, the cup is caused to enter through an opening in the side of the tube, and discharge the seed into it. The seed falls to the bottom of the tube, but cannot pass through the opening of the nozzle into the dibbled hole until the central rod rises therefrom; at which moment, the bent arm moves backward for a fresh supply of seed; and as the arm returns, the rod descends,—its enlarged end passing into and through the opening of the nozzle, so as to ensure the delivery of the seed, and to close such opening before the cup discharges a fresh quantity into the tube. When the parts are in the position just described, the dibble is lifted out of the earth, carried onward a suitable distance, and again caused to enter the earth, to form a fresh hole; and then the above movements are repeated.

Messrs. Dufaur and Co. contributed an eight-depositor hand-dibble, the invention of Dr. Newington. This implement consists, in the first place, of a long seed-box, from the top of which two standards or uprights rise, and are connected by a cross-piece or handle. The lower part of the seed-box is formed with a long slot or opening therein, extending from one end of the box to the other; and through this opening there works a narrow frame, the sides of which are enclosed by metal plates, forming a hollow casing. The lower part of this frame is formed with a V-shaped edge, so as to penetrate slightly into the earth when pressed downwards; and through this V-edge eight openings are formed to receive a like number of solid rods or dibbles, which are enclosed in the metal casing, and are attached at the top to a fixed bar of the seed-box. On the front side of the lower bar of the frame there is a small ledge or step for the foot of the operator, to aid in depressing it; and at the upper part of the frame two standards, connected by a cross handle, pass upwards through the top of the seed-box. The frame carries, within the seed-box, a horizontal bar with recesses for the reception of seed in the edge thereof; this bar, when the seed-box is raised, is brought below the surface of the seed contained therein, and the recesses severally receive a supply of seed, which they retain by means of the edge of the bar moving in contact with the dibble bar as it rises; and when the dibble bar, in its descent, passes below the seed-bar, the seed falls from the recesses into the lower part of the metal casing before mentioned. The operation of dibbling is performed as follows:—The operator, grasping the implement by the cross-handles, presses the V-edge of the frame and the dibbles (which now project therefrom) into the soil, so as to form the holes for the reception of the seed; he then raises the seed-box and dibbles, leaving the frame still upon the earth; as the dibbles rise, they pass through the openings in the V-edge of the frame, and thus permit the portions of seed in the lower part of the casing to fall through the openings into the dibbled holes; and after this, the seed-box and dibbles are lowered, so that the latter will again pass through the openings of the V-bar, and press the seed properly into the dibbled holes. During the ascent of the dibbles, the seed-bar receives a supply in the manner before described; and the seed, when the dibbles have completed their subsequent descending movement, is delivered into the metal casing, from which the previous supply of seed has been discharged into the earth. After the descent of the dibbles, the operator lifts the implement to a fresh spot; and the above actions are then repeated.

A single-hand dibble, invented by Mr. Eaton, of Woodford, consists of an iron frame, or double rod, with a cross handle at the top, and at the bottom a hollow dibbling point, divided in half, vertically,—one half being fixed, and the other being capable of sliding down a short distance below the fixed half. As the dibble is forced into the earth, the two parts coincide in position; but, when it is lifted from the hole, the fixed half rises before the moveable half, and permits the escape of a portion of seed, which is supplied to the dibbling point through a tin tube, placed between the two stems of the rod.

Mr. Eaton likewise exhibited a dibbling apparatus, to be worked by horse-power. In this apparatus, twelve of the above-described dibbles are suspended in two rows, by straps, from a frame, which alternately falls and rises again, so as to permit the dibbles to descend and penetrate the earth, and then to lift them therefrom. The dibble-frame is carried by the framework of the machine, which travels on four wheels; and the hind wheels are each provided with four crank-pins, which, as the wheels rotate, come against a curved part of the dibble-frame and raise it.

Mr. Winder, of Ingram-court, Fenchurch-street, shewed a dibble with a rising and falling point, connected to the body of the dibble by a screw-bolt, the head of which works in a channel in such body. There is a spring beneath a shoulder at the upper part of the point, which ordinarily keeps the enlarged part of the point up to the body; but, when the dibble is raised, after forming a hole, the adherence of the soil overcomes the spring, and retains the point in the hole for an instant; by which means, the end of a small seed-passage in the body of the dibble is uncovered, and the seed descends from the same into the hole. When the dibble is completely raised from the hole, the spring again brings the point up to the body thereof. The seed is supplied from a seed-box by a gutta-percha tube.

We must not omit to mention a useful little implement, manufactured by Messrs. Holmes and Sons, of Prospect-place, Norwich, for making good the deficiencies in rows of turnips, occasioned by the fly. To the bottom of a light wooden rod a small coulter is pivotted, near its centre, and is connected, at its upper end, to a small slide, with a hole in it, which works in the lower part of a funnel containing the turnip seed—the funnel being also affixed to the rod. When the coulter is pressed into the soil, to form a hole for the reception of the seed, it turns on its axis, and thereby draws the slide into the proper position for permitting the seed to descend through the funnel to the earth. On the implement being raised, the coulter and slide are caused to move back again by a spring.

Of the rotary dibbles, that exhibited by Mr. Newberry, of Hooknorton, Oxfordshire, appears to claim priority of attention. In this machine there are five revolving dibbling-wheels, mounted side by side in separate frames, which are hinged, at the fore end, to the framework of the implement, and are supported at the back by chains, to admit of the several wheels rising and falling independently of each other. The dibbles are hollow, or tubular, and radiate from the central hollow of the wheel, into which the seed is introduced by a conductor from a seed-box above, and thence passes into the dibbles: each dibble-wheel has a separate seed-box. The dibbles terminate in blunt rounded points, which project from the periphery of the wheel, and form holes in the soil as the wheel rolls onward. To effect the deposit of seed in the holes, each dibble is divided, lengthwise, into two parts, one of which is fixed immoveably to the wheel, and the other is capable of sliding outwards, so as to permit some seed to escape. The sliding half is furnished with a small stud or roller, which travels in an excentric groove, formed on a circular plate affixed to the frame that carries the wheel; and this groove is so formed that the two holes of the dibble will be exactly coincident while it is penetrating the earth; but when, by the onward progress of the wheel, the dibble is being withdrawn from the hole, the moveable half will be caused to slide outwards, and allow of the deposit of the seed; after which the sliding part moves back to its former position. The framework of the implement is like that of an ordinary cart, having a pair of shafts for a horse, and running upon two wheels.

Mr. Lampitt, of Banbury, contributed a four-row dibbling apparatus of a similar character to the preceding, but differing therefrom in some of its details. In this implement, the dibbles are solid, and are cast in one piece with the rim of the wheel; and in the side of each dibble there is a recess for the reception of a tumbler, whereby the seed is deposited in the dibbled holes. The tumbler consists of a hollow case, open at each end—the outer end being rounded, to suit the curvature of the lower part of the recess in the dibble. It turns on a pivot at the back of the dibble, and works through a slot in the periphery of the wheel. To the inner end of the case is fitted a funnel-shaped pipe, for introducing seed into the tumbler; and it is also furnished with two lever bars, which, on being acted upon by a rod from an excentric, cause the tumbler to turn on its point, and, by moving its end out of the recess, to deliver the seed. The seed in this machine is contained in a hopper, having at the bottom a rotating barrel, with recesses in its periphery, which delivers a suitable quantity of seed into each of the funnel-shaped pipes, as the tumblers severally pass it, during the rotation of the dibbling-wheel. Each tumbler retains the seed until it arrives at the lower part of the wheel; and then, being acted upon by the rod before mentioned, it delivers the seed into the hole formed by the dibble.

A two-row corn and seed dibbler, invented and exhibited by Mr. East, of Spalding, consists of an iron frame, supported by a pair of hind wheels and a single fore wheel, and fitted with suitable mechanism, which is actuated by turning a handle, for raising or lowering the fore and hind ends of the frame simultaneously. At the lower part of the frame, near the middle of its length, there is a horizontal axis, carrying two wheels, with solid conical points or dibbles projecting therefrom, which, as the machine is drawn onward, form dible-holes in the soil. Seed is introduced into these holes by two small depositing wheels, which receive motion from the axle of the dibbling-wheels, and are supplied with seed, by means of funnels, from a seed-box above. Each depositing-wheel is placed in a case, which has, at the fore part of it, a small presser or coulter, to form a shallow groove in the soil in the line in which the dibble-holes have been made. A small harrow is fastened to the back of the machine, for the purpose of covering the seed with earth.

Mr. East also exhibited one of his dibbling-wheels, constructed in such manner that each dibble will turn partly round in the earth, and thus make a cleaner hole. For this purpose, four equidistant radial arms are affixed to each dibble; and when, by the motion of the wheel, it is brought to the lowest point of the circle of rotation, one of the arms comes in contact with a small adjustable projecting piece, attached to a fixed part of the framing; and thus the dibble is caused to perform one-fourth of a revolution each time that it enters the soil.

The Rev. T. Digges La Touche contributed a model of a two-row turnip dibbler. It consists of two concave rollers, revolving on independent axes in a line with each other, and followed by two dibbling-wheels, which form holes for the reception of seed in the ridges made by the concave rollers. To the axes of each dibbling-wheel two arms are attached, and project forward to carry a scraper, which rests on the surface of the corresponding concave roller, and removes any soil that may adhere thereto. This dibbler is not provided with any seed-depositing apparatus.

BROAD-CAST SOWING MACHINES.

The Exhibition contained very few specimens of broad-cast sowing machines; and those were, for the most part, constructed for sowing grass seed,—but one being intended to sow grain. These implements are of simple construction, and are chiefly worked by hand. They may be generally described as consisting of a narrow trough or seed-box, from six to twelve feet long, placed, in a horizontal position, across a carriage resembling a wheel-barrow, when the implement is impelled by manual labor; but the carriage is constructed differently, and fitted with two or three wheels, when it is to be drawn by a horse. When the seed-box is twelve feet long, or thereabouts, the ends are usually made to fold over, to admit of the apparatus passing through narrow gateways. This box is formed with numerous openings for the delivery of the seed, and is fitted with suitable means for throwing out the seed. These means vary, and constitute the principal difference between the machines made by various makers.

Messrs. Garrett and Son's prize hand-barrow drill, before alluded to, is adapted for sowing two kinds of grass seeds together. These, if previously mixed, are apt to separate by the motion of the implement—the heavier seeds descending to the bottom of the seed-box; but, to prevent this, and ensure a regular delivery of both kinds of seeds, the box is divided longitudinally into two compartments, of which the lower is to contain heavy seeds, such as clover, trefoil, &c., and the upper is for lighter seeds, such as rye-grass. The heavy seeds are delivered to each conductor by a cup-wheel, and the light seeds are simultaneously impelled, by a rotary brush, through a small pipe into the same conductor, so that both seeds will fall to the ground together. The relative quantities delivered can be regulated by means of adjusting slides for the light seeds, and by changing the cup-wheels for the heavy seeds.

Messrs. Holmes and Sons, of Norwich, exhibited a hand-barrow drill for sowing grass seeds. In this implement, a long shaft extends through the trough or seed-box, and carries a series of wheels, having cups on each side, which take up and deliver the seed into a hopper on each side of the wheel; and the seed falls therefrom through channels of the shape of an inverted funnel or hopper, whereby it is distributed over a greater extent of surface as it descends to the ground.

A drill for sowing grass seeds and turnips on the flat was contributed by Mr. Windsor, of Oswestry, in which the delivery-openings of the seed-box or trough were fitted with perforated circular plates or slides, moving excentrically on a pin to adjust the size of the openings; the seeds were ejected through the openings by rotary brushes; and the bottom of the box was inclined, so as to cause the seeds to fall to the brushes until all were delivered.

Mr. Watt, of Biggar, Scotland, exhibited a broad-cast sowing machine, for grain and grass seeds, to be drawn by a horse. It consists of a low frame, running upon three wheels; —there being a pair of wheels to support the front bar, which carries the shafts for the horse, and a single swivel-wheel behind. The long seed-box, which rests on this frame, is formed in three parts, hinged together in such manner that the end parts can be folded over upon the central one, when the implement is to be drawn through a narrow lane or gateway. The shaft that extends through the box is divided into three corresponding lengths, connected together by sliding sockets or coupling-boxes, so as to admit of the same being readily disconnected; and it carries a series of small wheels, with radial blades, which project the seeds through the openings in the bottom of the seed-box.

In the Prussian department there was a model of a broad-cast sowing machine, consisting of a seed-box, mounted on a pair of wheels, and fitted with shafts for a horse. The seeds descend from the discharge-opening of the seed-box on to an inclined board, having three triangular-shaped projecting pieces thereon, arranged pyramidally beneath each hole, which distribute the seeds evenly as they fall to the earth.

DECORATIVE ART.

In bringing to a conclusion our papers upon "Decorative Art," considered in connection with the contents of the "Great Exhibition," we now lay before our readers the subject of wood carving, in its application to decorative purposes, and to the construction of articles of furniture.

Like ornamental works in the precious and inferior metals, which we have already had under our notice, wood-carving belongs to that style of art in which effect can only be obtained by varieties of form; as, under almost all circumstances, the employment of color is totally incompatible with this style of work, and when introduced, must be used with the greatest caution and judgment. Wood carving is sculpture, to all intents and purposes; and although the objects are achieved by different means, they are similar in every respect. Like every other branch of art which was especially applicable to church decoration, wood carving made a very considerable progress in the middle ages—the days wherein the Roman Catholic church was in her greatest pride and power, and commanded the unlimited enthusiasm of all classes of the community. This art advanced, in all probability, *pari passu* with the development of the science of church architecture, with the art of glass staining, with that of the ornamental metal work chiefly used at this early period, and, indeed, with every other art then so freely made subservient to church purposes; although, from the remains of ancient carving still extant it cannot be inferred that this art advanced to an equal extent with the others. As a matter for reflection it is curious to observe how entirely, in the question of the useful and ornamental arts, the church became the link which bound together remote ages. During the long period of the prevalence of the feudal system in Europe, the arts and sciences remained—at least so far as the people in general were concerned—in an almost complete state of abeyance: their only points of vitality were to be found in the establishments of the church; and these became afterwards the nuclei from which, when civilization began to dawn through the darkness of the times, a knowledge of the principles of most of the useful, and, we may say, all the ornamental arts, began to extend themselves into society at large. Of all that appertained to the cultivation of intellectual pursuits, the monasteries were the only nurseries, and the monks the only exponents, independently of their literary labors; they were the artists, the men of science, and, in many cases, even the artisans of the period; and it was only through their fostering care that the gems of many a useful art were brought down to a period in which they were enabled to take root and bear fruit abundantly for the extended advantage and benefit of later times. It would be a vain and fruitless task to attempt to learn anything of the early history of wood carving. This art must have originated at a period far too remote to have left any record of its events; and, indeed, of all the ornamental arts, this is perhaps the most primitive, and the one which was first practised by man in his most uncultivated state. It is, however, an art which has always gone on improving, as greater skill was gradually acquired in constructing tools suitable for the purpose of cutting wood; for, in addition to artistic ability, the wood carver must possess great manual dexterity, and a facility of execution which must depend in a great measure upon the nature of his tools. The first carvings were no doubt executed—like those of certain aborigines at the present time—by means of sharpened stones; next, a rude knife would in all likelihood be the instrument employed; and the art itself would progress as the means of execution became more extended, or better adapted to the object in view. The earliest specimens of decorative wood carving, which can lay claim to the title of works of art, are marked, in many respects, by the same artistic feeling which generally characterize ancient artistic works. We have laid down all through our essays upon decoration the broad principle, that unity of effect and appropriateness of design to situation must be, under all circumstances, the leading features of ornamental art. In wood-carving these principles ought to be as strongly maintained as in any other branch of decoration, and, in some respects, perhaps even more so. Their observance is peculiarly adhered to by the early artists; but it must not be forgotten that the applications of carved ornaments were then much more limited than at present: consequently, there were fewer opportunities for the artist to err in this respect. Carving was then almost entirely devoted to religious buildings, and the furniture belonging to them: the rules which would guide the artist would, therefore, be comparatively few, with regard to the style of ornament considered applicable to such a purpose. At the present time, carving in wood is a most important art in connection with the general ornamentation of household furniture, in addition to its continued application to the decoration of the interiors of ecclesiastical and other public buildings.

The use of carved ornament has become almost universal in furniture; and so great is the demand for this kind of work that it has assumed a kind of commercial character, leading to the introduction of mechanical means of lessening the trouble and expense of repeating such works, when required in large quantity, as is often the case.

The collection of specimens of carved wood lately exhibited in the Crystal Palace was so numerous, and, at the same time, so various, as to afford us the means of arriving at a judgment as to the comparative applicability of this style of ornament to decorative purposes. The first conclusion that forced itself upon our minds was, that wood-carving is not an advantageous medium for high art,—that, although, in carving, the effects are produced by a species of sculpture, it cannot, under any circumstances, be applied advantageously to the reproduction of the human figure. Every instance in which this was attempted appeared to us to be a failure. The proper function of wood-carving is undoubtedly mere decoration; and although there were exhibited some wonderful examples of artistic skill (as, for instance, the works of Rogers and Son, of London, and Wallis, of Louth, in Lincolnshire), there can be no doubt that in this particular direction the applications of wood-carving are but limited. One of the greatest defects in this branch of decoration consisted in the employment of a class ornament, in which the chief efforts of the artist had been directed to the production of a mass of sculpture, purporting to represent groups of natural objects, or symbolizing some circumstances connected with the nature of the decorated object. This was productive of two evils: firstly, the object itself was often so laden with ornament, that it became completely inappropriate to its intended use,—the ornament also being, in many instances, quite out of character; and, in the second place, the symbolical design frequently embodied a story difficult to be traced out, and, perhaps, bearing but a remote relation to the uses of the object. The fact is, that in ornament of this kind, conventional designs are the most suitable in every respect; as we saw in the Chinese porcelain, the Indian shawls and carpets, and, what is more to the point, in the carvings exhibited in the Indian department. It is not only unnecessary that natural objects should be imitated—that our furniture should be half pictures; but it is far better that it should not be so, —that designs should be adopted, created out of mere conventional combinations of forms, and employed with reference to the appropriateness and elegance of the ornament, and not to the closeness with which some totally unsuitable natural object is imitated.

Carving in wood is clearly as capable of giving expression to any particular style of ornament as metal work, or indeed any other medium of decorative art; but we question if any branch of ornamentation has been more completely left at the mercy of workmen, generally uneducated in the principles of decoration, even as far as they have been developed in this country. We speak now of the style of carving so extensively employed in connection with manufacture, and not of that sculptural style in which the great master Grinling Gibbons has been followed by Rogers and others. Most of those who pursue the occupation of carving, do so as a trade, and not as a branch of art; although, strictly speaking, wood-carving, for decorative purposes, ought certainly to be considered as much a branch of art as the goldsmith's work, which, in earlier ages, was looked upon with so much admiration. Now, as carving is entirely a manual process, executed without the slightest extrinsic aid, excepting that of the graver, to produce artistic effects, it is obvious that the carver must possess the mind and hand of an artist. A careful examination of the works exhibited proved that such at least, in most cases, was not the case. The furniture carvings had evidently been executed after some established routine method, and generally possessed not the least claim to be considered as works of art. In the carvings of Rogers and others of that class, the resources of this art were probably carried to their utmost extent; and, with the exception of some carvings in pear-tree wood, by Lienard, of Paris, they far surpassed any works of the kind exhibited. But these, properly speaking, cannot be viewed as decorative carvings: they have little more to do with decoration than the pictures which hang upon the walls, or the statues which line the vestibule of a mansion. In decorative or furniture carving, the French and Austrians are far more successful than ourselves. We will refer to the Austrian furniture, the celebrity of which became universal during the time it was exhibited. Without reference to the design, the manual skill displayed in the carving was far beyond that shewn in the English furniture: the carvings possessed a boldness and vigour, combined with a crispness of outline, which could only have been produced by the hand of an artist. In most respects, too, the designs of this furniture were also superior. One of the most elegant and characteristic works of this kind was an ebony cabinet, exhibited by Le Prince, of Paris;—the style was Renaissance, and the ornaments were beautifully executed and admirably appropriate in themselves.

Another fine work, although possessing the defect we have already alluded to, over ornamentation of the symbolical kind, was the great sideboard exhibited by Fourdinois, a noble work, designed and carried out with great artistic feeling. This, taken altogether, was perhaps the finest piece of furniture in the Exhibition. We must not, however, forget the merits of the Kenilworth buffet; but although this contained some very fine carving, the large figures were generally defective, and proved the correctness of our remark that carved wood is not a medium fitted for the execution of sculptural works: the procession, representing the entrance of Queen Elizabeth into Kenilworth Castle, was, however, extremely good; and the general style of the work worthy of praise. It must be evident that, as wood carving is a process executed entirely by hand, elaborate works can only be obtained at a very considerable cost,—a cost which, if the works be extensive, soon amounts to a sum which places wood-carving of a superior kind quite beyond the reach of any but the wealthy: except as a means of ornamenting furniture, to a greater or less extent, it is obvious, therefore, that the use of wood-carving must be very limited. In the time when books could only be multiplied manually, and the illuminated volume required month after month to be spent in the labor of its production, they were necessarily so costly that they found their way into but few hands; and so it is with such an art as carving: a work of any extent can only be accomplished slowly, and the labor necessarily bestowed upon it enhances its value to a very high degree. We live in a utilitarian age, however; and it was naturally to be expected that some effort would be made to apply the wondrous resources of machinery to this as well as to other branches of productive art. Such has, indeed, been the case; and in the Exhibition we had the opportunity of examining the result.

The Wood-Carving Company exhibited a piece of screen-work, 16 feet in height, for the interior of a church, besides other specimens of carving, executed by machinery. Of course this mechanical method can only be applied with the utmost advantage, of which it is susceptible, to the production of works which require to be repeated; although at the same time it must be remembered that its employment is by no means limited to the mere reproduction of repeat patterns on one plane. We believe the original practical application of a mechanical apparatus to the copying of works in relief, and indeed even of sculpture, is due to Mr. Cheverton, who employed it in producing reduced copies of busts, figures, or any kind of designs in relief. Specimens of carving in ivory, executed by this means, were exhibited by Mr. Cheverton in the Fine Art Court. They were remarkable for their excessive accuracy as copies, many of them being from well-known originals, and also for their high degree of finish and delicacy of effect.

Many different kinds of apparatus have been devised for the multiplication of wood-carvings, or for copying, in wood, models previously executed in some other material. As a commercial question, it must be of great importance to have the power of reproducing at will, by the mere operation of machinery, copies of works upon which the very highest order of art has been expended; and it is evidently only through the medium of such a system that carved decoration can ever become more extended in its use, independently of mere furniture ornament. In ordinary carving by hand the same amount of labor is required to produce an equal effect, no matter how often the work has to be repeated. Not so where the carving is executed by machinery. The great labor, and, indeed, almost the only manual labor, is expended upon the original model, which is, as it were, the matrix from which all the others have to be produced. Under such circumstances, the artist is justified in bestowing upon it an amount of time and work which can only be remunerative when the cost is spread over a large number of copies, produced by an after process.

In the only successful method of carving by machinery, the broad principle consists in cutting away the surface of the wood, in which the pattern or figure is to be produced, by means of drills, the course of which is determined by a fixed tracer-point, with the motions of which that of the drills is made to correspond with great exactness. The tracer can be applied, by means of certain mechanical arrangements, to the surface of the work to be copied;—the horizontal movement of the tracer being easily regulated by the workman, who manages the machine. As the point of this instrument passes over the model, following the curves and irregularities of its surface, the drill passes over the surface of the wood to be carved, and, being kept at the same time in rapid rotation, cuts away the surface until its depressions and eminences correspond exactly with those of the copy. The whole operation consists in cutting away some parts—leaving others in relief; and, as the drill cannot cut below the level of the tracer, and as that follows the lines of the model, it is evident that, in this manner, a copy of the latter, more or less perfect, must be produced. That such a process must be, in many respects, of great value, there can be no question. Even if it were capable of doing no more than the roughing out of the design, removing the superfluous mass of material, and bringing the whole into a proportionate condition, it would have done much: an amazing amount of hand-labor would have been saved; and it would only require to be finished up by the tool. This after-finish is, indeed, necessary, to a greater or less extent; but the work, when removed from the machine, may have been brought (when desired) into a very perfect state, requiring but little after assistance from the carver: it is not here that the difficulty lies. As a question of art, however, the case is somewhat different; but, in the commercial sense, this invention of wood-carving is excellent. There are numberless cases in which carving is employed where a mere perfection of execution, a mechanical regularity, and a sharp outline, take the place of a higher kind of merit. When, for instance, it is necessary, as in Gothic wood-work, to merely repeat the same design—the same panel, or the same frieze, an infinite number of times, machine carving is equal, in every respect, perhaps superior, to hand carving; but where anything approaching to art is required, then the old method reasserts its supremacy. The touch of the artist is just as evident in a piece of wood-carving as it is in a sketch upon the canvas: it was in this that the carving upon the Austrian furniture so far excelled the English furniture carving. In the former you could perceive every touch of the graver: it was sharp and vigorous, as if the hand of the workman had been directed by a mind which thoroughly comprehended and mastered the difficulties of the task. In the English carving, excepting the kind of carving we mentioned before, all was smooth, and round, and edgeless: it gave the idea of having been all polished up with glass-paper, to remove touches of which the artist was ashamed. Machine carving possesses a similar defect: there is a want of that vigorous touch which can only come from the trained mind and hand.

Mechanical cutting away the surface, although we believe the only successful method employed for multiplying copies of designs on wood, is not the only one that has purposed to effect this object. In a plan, which was novel and ingenious in idea, a hollow mould of the work to be copied was executed in cast iron, and its internal surface made as perfect as possible, and brought to a high degree of finish. In order to produce a copy of this mould, it was heated to redness, and placed upon a piece of wood prepared to receive its impression. The hot iron necessarily consumed the portions of wood with which it was in contact,—reducing them to charcoal, which could easily be removed. This process was continued time after time, until the superfluous wood was quite removed: the block must then necessarily fill up the mould a rough copy of which would thus have been produced. Now, in relation to the art of wood-carving, it must be manifest that such a contrivance could have but very little value. A copy of any object produced in this manner could be nothing more than a rough approximation to its form. It is true that such a proceeding may diminish, in some degree, the labor of reducing the mass of wood to a size somewhat proportional to the work; but, in saving labor in one direction, it would entail double its amount in another; and altogether we can scarcely view the process as anything but quite impracticable, although it indicates considerable ingenuity in conception. After all, the means by which the carving is produced must be a secondary matter for consideration, as compared with the artistic part of the question. Carved wood is, under many circumstances, a most appropriate and beautiful style of decoration, and we desire to see its employment, as a means of ornament, brought under the influence of the same principles which should govern the application of ornament in every case. It matters but little whether the object to be ornamented be a carpet, a porcelain vase, the furniture of a room, or the interior of a public building. The first great principle is to make the ornament suitable to its situation; the second, to render the ornament agreeable to the eye through the skilful adaptation of its forms and color; the third, to make the ornament subservient to the object decorated, and not the object a mere means of exhibiting the ornament.

THE INDUSTRIAL EXHIBITION CONSIDERED IN ITS POLITICAL BEARINGS.

It is said to be a peculiar characteristic of great men, that they are enabled to bend circumstances to their will; but not a few are the instances presented by history of circumstances thwarting the designs of the most powerful and resolute of mankind, and making even nations unwillingly submit to an overpowering necessity. The reason for this is obvious enough to the keen observer; for success depends far more upon the nature of the end sought to be attained, than the amount of means at hand for its attainment. It is truth alone that can eventually triumph, whatever amount of temporary success may wait upon the exertions of self-interest, backed up by artifice or physical force. To the political economist, the knowledge of this fact serves to explain why the supposed judicious policy pursued by our legislature with respect to the mercantile interests of Great Britain for the last three centuries is now doomed to an utter reversal. That this must be the ultimate result of the late successful display of the products of industry of all nations in Hyde Park we have no doubt, although it may be reserved for a future age to prove the correctness of this opinion. In the meanwhile it may be well to examine a little into the probable bearing of the Great Exhibition upon the industry of the world; for such an enquiry will form an appropriate termination to our labors of reviewing the contents of the Crystal Palace, and the processes connected with their production.

During the earlier ages of the world, when mankind was in a more primitive state, and the science of political economy was yet unborn, nations, acting up to their twilight knowledge, considered it sufficient grounds for the establishment of mercantile transactions with each other, that one country was able and willing to furnish what another was desirous of exchanging for a proper equivalent; and, by affording every facility for such exchanges, a mutual benefit was supposed to be derived therefrom. This was not only the system adopted in the ancient world, but even in modern Europe it was found to conduce greatly to the wealth of those Powers who fostered its growth. In the reign of Henry III. we find an Act passed, which gave to all merchants, unless otherwise expressly prohibited, safe conduct either to leave or enter England, to stay in one place, or travel through the country, for the purposes of commerce;* and this was confirmed by an Act of Edward III., which declared that the sea shall be open to all merchants to pass where they please;† and also by others of like nature. Not long after this commenced that system of excluding foreign manufactures and produce, which, when fully developed, completely stultified those Acts which were eminently calculated, even at that early date, to raise this country to opulence and renown. It would be a curious subject for enquiry, to ascertain in what proportion the obloquy of this policy might fairly be divided between the Crown and the people; for, whatever might be the personal advantage which the prince derived, from granting a monopoly of a manufacture to an individual, or a guild, it was for the exclusive benefit of the party privileged to undertake a particular manufacture within the realm that the foreign production was inhibited. As far as we have been able to discover, monopolies seem to have increased in proportion to the pecuniary embarrassments of the reigning sovereign. This would seem to indicate, that the creation of such privileges was tacitly understood to be the arbitrary disposal of the natural rights of the subject, to provide for the necessities of the Crown. But so pernicious was the effect of this system to the interests of the country at large, that even that arbitrary princess, Elizabeth, felt obliged to cancel the most odious of the exclusive privileges which she had created. It was, as is well known, in the reign of James I. that the limits of the prerogative of the Crown were defined; and all power of granting monopolies, of whatever kind (with the exception of patents for inventions) was vested in parliament.

To watch the progress of the legislature from this period, with respect to trade and manufactures, is not a little instructive; for, from a survey of its proceedings, we gather unmistakeable evidence that the system of monopolies can be traced to no other source than the selfishness of human nature:

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* 9 H. III., c. 30. † 2 Ed. III., c. 9.

its aim is, and can be no other than, self-interest as opposed to the general good. By transferring the power from the sovereign to the legislature, although the same spirit presided at the councils, and prompted the actions of both, there was, nevertheless, this advantage gained, viz., that the limits of the proscription became considerably enlarged, by all British subjects being admitted to the privileges which had heretofore been confined to an individual, or a small company of traders. Instead of reverting to that sound policy which was adopted by Edward III., we find, in the reign of Charles II. that restrictions were made by parliament to the exclusion of aliens, in supplying vendible commodities to any of the lands, islands, and plantations, belonging, or which may belong, to the king or his successors in Asia, Africa, or America, on pain of forfeiture of their goods.* Not to dwell too minutely on the retrograde steps taken to bring our mercantile relations with foreign states to the unsatisfactory position which they, until very recently, held, we may remark, that in proportion as the representatives of the people became aware of the importance of industrial habits to a civilized community, so were their legislative measures directed to the shutting up, if it were possible, within the limits of the British Empire, all the good that might be expected to flow from the industry and skill of its inhabitants. Thus, in the reign of George II., when, with the growth of science generally, it might fairly have been supposed that some advance would have been made in fathoming the mysteries of political economy, an Act was passed, by which any person soliciting an artificer in any manufacture of Great Britain or Ireland to go abroad, became liable to the forfeiture of £500, and to one year's imprisonment.† Again, so late as the third year of William IV., we find an Act passed for the general regulation of the customs wherein, among other matters, the exportation of all kinds of machinery pertaining to the manufacture of woollen, cotton, linen, or silk goods, also of tools or engines having reference to any manufacture carried on in this country, was totally prohibited.‡

The design of these laws was obviously to prevent the acquisition by foreigners of the knowledge and facilities possessed by English artisans for the prosecution of their daily labors; as if it were any more in the power of a self-aggrandising government to stay the progress of intelligence than to control the restless ocean! It is well to notice (because it gives a key to the frequent anomalies discernible in modern legislation), that the same influence which dictated the enacting of these prohibitory laws was also the cause of their abrogation. After it had been demonstrated that no punishment which a British government dare inflict, was adequate to prevent enterprising artisans from applying their skill where it was best remunerated; and that the risks incurred in exporting tools and machinery did not deter foreign capitalists from providing themselves with the most perfect specimens of British construction (from which foreign workmen could easily manufacture any number required, and thereby render it unnecessary to apply again to England), self-interest came again to the rescue. It was now evident, that the establishment of textile and other manufactures, after our mode, could by no means be prevented abroad; and it was therefore thought, that as we could no longer hope to command an exclusive market for the goods manufactured from our machinery, it would be well, at least, to secure the manufacture of the machinery itself; and hence emanated the Act of 1843,* by which so much of the Act of William as related to prohibiting exports of machinery was repealed. The time had now, however, arrived for a counter-action on the part of foreign governments; for the manufacture of those machines and tools which they had been once so desirous to import, was now, by dint of foreign capital and English skill, become a staple branch of home industry with them; and the same feeling, therefore, which thus tardily prompted the free exportation of our utilitarian works in metal, urged the foreign makers to demand protection against their competitors abroad. Such has long been the policy of all civilized nations in respect of their commercial relations with each other; for, if they have been slow to adopt the unselfish theories of Adam Smith, they readily enough received and acted upon the maxim of an earlier writer,—that "when the country exported to a greater value than it imported, a balance became due to it from foreign nations, which was necessarily paid to it in gold and silver, and thereby increased the quantity of those metals in the kingdom; but that, when it imported to a greater value than it exported, a contrary balance became due to foreign nations, which was necessarily paid to them in the same manner, and thereby diminished that quantity."* It is still clearly the desire of all the governments of the civilized world to make their exports exceed their imports, and thus obtain a balance in their favor; or how else can we reconcile the policy that excludes, by protective duties, any natural produce or manufacture that would otherwise be imported? We are told, by Adam Smith, that the precious metals are no more to be desired than any other marketable commodity; and also, that it is unwise in statesmen to attempt to direct the application of the capital of private individuals. But the tendency of protective duties is, as above mentioned, to give importance to the accumulation of specie; and also to divert the application of capital to unnatural channels. This latter assertion is thus supported by our authority: "To give the monopoly of the home market to the produce of domestic industry, in any particular art or manufacture, is, in some measure, to direct private people in what manner they ought to employ their capitals, * * * for, if the produce of domestic, can be brought there as cheap as that of foreign, industry, the regulation is evidently useless." The true policy, therefore, for governments to pursue, is to abandon the attempt to obtain an unfair advantage over other states in their mercantile relations, since it must, sooner or later, end in failure; for no isolated interest can be protected but at the expense of the rest of the community; and, indeed, in some cases, the grant of a monopoly will be found to produce the very opposite effect it was intended to give. The unjustifiable stoppage of our supplies of sulphur from Sicily (noticed at page 456 *ante*) is a remarkable case in point, as it drove English manufacturers to find an efficient substitute therefor among our own mineral productions.

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* 12 Car. II., c. 18. † 23 Geo. II., c. 13. ‡ 3 & 4 W. IV., c 52.

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* 6 and 7 Vic., cap. 84.

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* Mun's *England's Treasure in Foreign Trade*, quoted by ADAM SMITH, Book IV. c. 1.

It is a circumstance likely to take a creditable place in history, notwithstanding the doubts at present entertained respecting the recent change in our foreign commercial relations, that England, who has never been backward in furthering every noble project started for the benefit of humanity, was the first to confess to the unsoundness of the system which had so long obtained credence in the councils of all civilized states, and ignore her opinion by a voluntary act which severely tested the consistency of her political faith. The abolition of the corn laws, followed, as it has been, and will yet further be, by remissions of almost prohibitive duties on foreign produce, is, we think, calculated, in its remote effects, to do far more for the permanent happiness of mankind than all the physical force revolutions that are recorded in the world's history. By taking this initiatory step, England has displayed a worthy example of disinterestedness; inasmuch as, with the certainty of no reciprocal benefit, at least from many quarters, she has thrown open to the merchants of the whole world the solid advantages of British citizenship,—recognizing, for the first time, the existence of that relationship between nations which we are taught should subsist between man and man, viz., the will to do to others as we would they should do to us. This example of retrogression towards unsophisticated truth, which, as we have seen, formed the basis of our earliest statutes, relating to commerce,[*] cannot but be followed, in due time, by other countries; and, when mercantile transactions are wholly free, we may perhaps find that stagnation in trade is as little to be feared as a glut of specie has hitherto troubled us. Before, however, the unfettered interchange of commodities can be thus brought about with advantage to all parties concerned either directly or indirectly in the traffic, it becomes necessary that the capabilities of all exporting countries should be thoroughly appreciated; and to that end is an exhibition of the products of industry of all nations—such as that we have had so recent an opportunity of examining—of the utmost service. Sufficient proof is presented in the series of papers which we have devoted to the consideration of the Exhibition, that the valuable hints which manufacturers might derive therefrom, for the improvement of their several branches of industry, must be numberless; in that respect, therefore, much good might be fairly expected to result from studying the contents of the Crystal Palace; but by far the most useful lesson which a careful examination of this unparalleled collection was calculated to teach, is the unmistakeable supremacy of the various nations in some particular manufacture, or in the natural facilities they severally possess for supplying some raw material required by the manufacturers of other countries. Information of this kind is, or ought to be, of the same value to nations that self-knowledge is to individuals; for, without it, how fatally wrong may the energies of a people be directed! To take a home example of this error—Ireland presents a melancholy instance of misdirected aims. It is far from our intention to lead our readers through the various departments of the Crystal Palace, and point out, on the one hand, the several branches of industry which each and all the nations may follow with certainty of success; or, on the other, to dictate what pursuits should be abandoned, to avoid inevitable disappointment; for, if, by possessing the knowledge of a seer, we were enabled to do this, the announcement of our judgment would be at least premature. The first and greatest step is to convince the powers that be of the folly of attempting to naturalize exotic branches of industry on an uncongenial soil; and, when this is once attained, a short experience of what pursuits are profitable, and what are not, will suffice to direct the enterprise of all nations into the channels respectively destined for its reception. Never, until now, has the means been provided for impressing this great lesson on mankind; but the response to the invitation sent forth by England, to contribute specimens of industry of all peoples, has furnished the most ample opportunity that could be desired. Viewed in this light, the Great Exhibition is calculated to produce invaluable benefits; for it was, in itself, a miniature representation of what the home market of every nation may become when all restrictive import duties are abolished, and merchants are left at liberty to represent the genius of their several countries in a manner most acceptable to the people with whom they are trading. Here was free admittance for all products, both artistical and utilitarian; but only a remote prospect presented itself of their advantageous disposal;—yet, with this and some other unavoidable drawbacks, we were supplied with a collection of articles, whose beauty, or more substantial qualities, were unprecedented.

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[*] In reference to this subject, we find the following remark from a learned writer:—"In the twenty-fifth year of the reign of that enlightened prince [Edward III.] a statute was passed, granting a free trade equally to foreigners and natives; and, had this admirable expedient of senatorial wisdom been suffered to remain in full force, the commerce of this country would have risen into notice at a much earlier period, and our political hemisphere would not again have devolved into utter obscurity."—*Essay on the Law of Patents*, by J. D. COLLIER, Lond., 1803.

The success of the Exhibition is sufficient evidence, not only of the existence of a general desire to supply foreign markets with every conceivable product of nature or of skill, but also to be possessed of every means capable of facilitating the various industrial processes. There seems to be little prejudice required to be broken down before men can be awakened to the advantages derivable from the modern advances in practical science; and little, if any desire, to shut out communities from the benefits accruing from the experience of others, is now perceptible. So far, then, public opinion in all climes may be said to have advanced; and it remains for those who hold the reins of power to imitate the example of England, by withdrawing the artificial barriers, which were raised in ignorance and have been supported by cupidity. That this will eventually result from the great gathering of the present year, is, as we have already indicated, our firm conviction; but, if we may judge from former experiences, this sweeping reform will rather be submitted to as a necessity than promoted by foreign governments. Should this sound policy, which is built on a principle of justice that cannot be controverted, meet, as we trust it may, with a speedy and universal adoption, the change will unquestionably be due to the potent influence of the Great Exhibition. In that case, there will be no need for material records to keep in remembrance the assembling of the nations in 1851, to commemorate the triumph of unobtrusive industry; for of this unexampled festival it may be said—*si monumentum quæris, circumspice.*

RECENT PATENTS.

To JOHN STEPHENS, *of the Albynes, in the parish of Astley Abbotts, in the county of Salop, Gent., for certain improvements in thrashing machinery.*—[Sealed 10th February, 1851.]

THIS invention consists in actuating the friction-surfaces of thrashing-machines, or those parts which disengage the seed from the plant, so that they shall act as rubbers, instead of beaters or strippers, as heretofore. By this means, the thrashing operation is said to be more perfectly effected than by the ordinary machinery used for that purpose, and that with a great economy of power and less injury to the straw.

In Plate VI., fig. 1, is a longitudinal elevation, partly in section, of so much of a thrashing-machine, constructed according to this invention, as will shew the nature of the improvement; and fig. 2, is an end view of the same,—being partly in section. *a,* is the main driving-shaft of the machine, turning in bearings in the main framing; *b,* is a drum, grooved on its periphery, and keyed fast to the shaft *a,* which also carries, at one end, a bevilled wheel *c.* This wheel *c,* gears into and drives a pinion *e,* mounted on a crank-shaft *f,* which turns in suitable bracket-bearings, projecting from the main framing. To the crank-shaft two rods *g, g*,* are connected; and these are severally attached to sliding-bars *h, h*,* by vertical studs, projecting from these bars, passing through the socketted end of the rods *g, g*.* These bars *h, h*,* slide in guides, made for them in the end framing of the machine; and, to their under sides, are attached ribbed or grooved friction-surfaces *i, i*,* by means of screws, which admit of the nice adjustment of the surfaces, as regards their distance from the drum *b.* *k, k*,* are weighted guide-rollers, for guiding the material, to be operated upon, into and out of the machine. The action of the machine is as follows:—Rotary motion being communicated to the shaft *a,* by hand or other power, the drum *b,* is caused to rotate, and with it also the bevil-wheel *c,* which, taking into the pinion *e,* as before said, will rotate the crank-shaft, and, through the rods *g, g*,* communicate a reciprocating motion to the friction-surfaces *i, i*.* The material to be operated upon (say, for instance, wheat) is fed into the machine between the drum *b,* and the roller *k;* which latter will be caused to revolve, in the direction of the arrow, by friction of contact, and pass the wheat under the friction-surfaces *i*, *i**; but, as these have a motion at right angles to that of the drum, they will severally rub the ears of wheat against the ribbed or irregular surface of the drum, and cause the seed to be disengaged therefrom. In order to effect this the more perfectly, the friction-surface *i**, is set nearer to the drum than the friction-surface *i*; so that those ears which fail to be sufficiently acted upon, while passing under the first friction-surface, will be made to yield all the seed they contain, by passing under the action of the second surface. The straw then passes off, being guided out of the machine by the roller *k**; and the seed, falling down, is acted upon by a blast of air from a fan in the well-known way (but not shewn in the drawing), for the purpose of winnowing out the chaff and other extraneous matters therefrom. To prevent the rising of the friction-surfaces *i*, *i**, under the upward pressure of the straw fed into the machine, antifriction-rollers 1, 1, are provided at either end of the machine: which rollers, by acting on the upper surfaces of the bars *h*, *h**, will enable them to resist the upward pressure put on their respective friction-surfaces, and thus keep the surfaces *i*, *i**, at their proper relative distances from the drum *b*. The motion of the machine is rendered uniform by means of the fly-wheel *d*, which is actuated by a cog-wheel 2, keyed on to the shaft *a*, taking into a pinion 3, on the stud which carries the fly-wheel.

This construction of machine is intended principally for thrashing wheat, peas, beans, &c.; but, for thrashing barley and oats, the patentee employs a modified arrangement,—the principle of action of which is precisely similar to that above described, although the means employed in carrying it out are somewhat different. Keyed on to the main shaft, which carries the drum, is a cog-wheel, which gears into and drives a pinion, mounted on a hollow shaft: this shaft turns in bearings in the main framing, and carries a fly-wheel, for steadying the motion of the machine. Through the hollow shaft a squared shaft, forming the axle of a card-cylinder, passes, for the purpose of receiving rotary motion therefrom, and communicating the same to the card-cylinder. The other end of this card-cylinder-shaft is cylindrical, and passes through a guide, affixed to the framing. The cylinder is embraced by a frame, which is provided with a vertical stud, to receive the socketted end of a crank-arm, through which a traverse motion is communicated to the card-cylinder. The agricultural produce, therefore, which is to be acted upon, is fed into the machine between the rotating-drum and card-cylinder; and, by the reciprocating motion of the card-cylinder, the same kind of rubbing action is communicated thereto as that before described: whereby the seeds will be effectually disengaged from the straw. The difference between the action of this and the above-described machine is, that the card-cylinder will, from the elastic nature of its rotating surface, act somewhat like a brush, and thus admit of a nearer proximity of the two friction-surfaces, without the risk of crushing, or otherwise injuring, the grain or seed; and, for this reason, it is better suited than the rigid surfaces for acting upon such produce as yields seeds smaller than wheat.

The patentee claims the application to thrashing machinery of friction-surfaces (whether rotary or not) having a traverse motion, whereby, in connection with a rotating friction-surface, the ears of corn, or other agricultural produce, may be subjected to a rubbing action, for the purpose above set forth. —[*Inrolled August*, 1851.]

To William Edward Newton, *of the Office for Patents, 66, Chancery-lane, in the county of Middlesex, civil engineer, for improvements in apparatus for the generation and condensation of steam for various useful purposes; also improvements in certain parts of engines to be worked by steam, air, or gases,—being a foreign communication.*— [Sealed 8th May, 1851.]

This invention consists, firstly, in improvements in the method of discharging that portion of the water from the boilers of steam-engines known as the "blow-off" water. The object of this operation is to free marine and other boilers, in which water, impregnated with marine salts or earthy matters, is used, from the effects that a calcareous or other deposit would have upon them, if allowed to accumulate on the bottom of the boiler. The discharge of these matters, while still in solution, is effected by an operation technically called "blowing off,"—that is, causing a certain amount of the saturated or nearly saturated water, which remains after the evolution of a given quantity of steam, to be discharged from the boilers at certain regular intervals. The water, at these periods of discharge, being loaded with these foreign substances, carries a considerable portion of it from the boiler, thereby clearing it sufficiently to prevent any injurious deposit or accumulation,—an amount of fresh water being constantly pumped in to supply both the quantity required for steam and that which has been blown off.

According to this invention, the feed and blow-off operate in unison; because the blow-off is wholly effected by the action of the feed-water itself; so that, when the feed-water ceases to enter the boilers, the blow-off also ceases,—the operation being such that, at every stroke of the feed-pumps, a certain amount of water is discharged from the boiler, to effect the blow-off. This is accomplished by causing a connection to be formed with the stem of the ordinary "check-valve," which is put on all boilers; so that, at every rise of the said valve, by the injection of water into the boiler, it is made to act on the stem of an outlet-valve, communicating with the same boiler, so that the said valve is opened sufficiently to allow of the escape of the blow-off water.

In Plate VI., fig. 3, represents, in sectional elevation, an arrangement for this purpose. *a*, is the ordinary check-valve; *b*, is the stem of the same, rising up through the stuffing-box in the cover. Immediately over this is affixed a delivery-valve, in such a manner that its stem shall terminate near the stem of *b*, as represented. A regulating screw-cap *c*, is attached to this stem, in order to regulate the opening of the blow-off valve. *d*, is a pipe, leading from the blow-off-valve to that part of the interior of the boiler from which it may be considered most advisable to take the blow-off water. *e*, is the discharge-pipe. The operation is effected by the rising of the stem *b*, which is forced up by the action of the feed-pump, in injecting the feed-water through the valve into the boiler. The cap *c*, is adjusted so as to be struck by *b*, in its ascent;—thus causing it to open the delivery-valve, and effect the blow-off. By means of the regulating cap *c*, the quantity of water blown off may be increased or diminished, as the case may require.

Under this head of the invention, the patentee's claims are for regulating the blowing-off operation by the action of the same mechanism which controls or regulates the admission of the feed-water; so that the blow-off water will always bear a certain proportion to the quantity of water fed into the boiler; and which ratio must vary, according to circumstances, so as to cease entirely when the "feed" ceases to enter the boiler. And particularly connecting the blow-off-valve with the check-valve, in such manner that the blow-off-valve will be operated by the stem of the check-valve.

The second part of the invention relates to a method of packing piston and other rods. The stuffing-box of a cylinder, made in the ordinary way, is bored out truly, and the annular portion of its bottom, between the sides of the box and the orifice through which the piston works, is turned down at right angles to the axis of the piston-rod, as shewn at fig. 4. Upon this annular bottom is placed a brass ring *a*, *a*, fitting the box, but having a play of, say, one-eighth of an inch around the piston-rod. On this ring is placed a brass cup *b*, which the inventor terms a vibrating cup: it is, externally, a cylinder, but shaped conically inside, so as to receive, in addition to the piston-rod, which passes through it, the metallic packing *c*, *c*. The packing, which may be made of brass, or composition metal, or Babbit's metal (which last is preferred), consists of several rings, of half an inch thick each, ground truly to each other, and fitting accurately with their internal edges around the piston-rod;—forming, externally, when laid one on the other in their place in the cup *b*, the frustrum of an inverted cone, whose upper or greater diameter is one-eighth of an inch less than that of the bore of the stuffing-box, and its lower and lesser diameter equal to the thickness of the piston-rod. These rings are divided in one or more places, and sufficient metal is taken out at the divisions to allow of a contraction of the rings as the wear of their internal surface against the piston-rod causes their parts to approach the centres of their circles. On the top of these conical rings, a metal ring *d*, *d*, similar to the lower one *a*, *a*, is placed; and over this ring—or else attached to the bottom of the cap or cover of the stuffing-box—one or more helical springs are placed, for the purpose of keeping a suitable pressure upon the said ring *d*: the effect of which will be to depress the packing into the conical-shaped chamber of the vibrating cup, and thereby thrust the packing inwards, so as to embrace the piston-rod, and effectually prevent the escape of steam, or ingress of air, along the rod; whilst the accuracy of the fitting of the outside of the packing to the cup, and of the rings to each other, and to the bottom of the stuffing-box, will prevent the escape of steam, or entrance of air, in any other direction.

For the purpose of conveniently regulating the pressure of the springs upon the packing, the inventor employs, in addition to the nuts for screwing down the cap of the stuffing-box, a set of nuts underneath the cap, so as to hold it exactly in any desired situation, and give a certain pressure upon the packing. The intention of the vibrating cup is to permit of that lateral motion of the piston-rod in the stuffing-box which necessarily arises, in the best-made machines, from wear of parts, loosening of joints, and other derangements, especially in machines which, like locomotives, are driven with great velocity over irregular surfaces, and made to undergo great straining of parts.

The claims under this part of the invention are, first, the employment of metallic packing, arranged, shaped, and combined in a peculiar way; viz., in a metallic matrix or cup, shaped and arranged as is above described, so as to allow a piston-rod or shaft, passing through or working in the stuffing-box, liberty to vibrate laterally to a sufficient extent to yield to the unavoidable irregularities of the engine to which it may be applied. Secondly, the combination of the conical-shaped matrix or stuffing-box with the metallic rings contained therein, and through which the piston-rod or shaft moves or works; so that, as the inner surface of the packing-rings wears away, the rings may, by the proper application of springs or screws (made to press them in the direction of the axis of the piston-rod or shaft), be advanced along the conical surface of the matrix, so as to maintain a perfect contact of surface both with the piston-rod or shaft, and with the internal conical surface of the matrix. And, thirdly, the use of the vibrating cup without the metallic packing: in which case, hempen or other packing may be used in connection with the vibrating cup.

The third part of the invention relates to a method of producing fresh water on board of steam-ships by the condensation of steam from the main boilers, or from an auxiliary boiler. The improvements consist, firstly, in combining a tubular condenser with the main boilers of a steam-ship, and with an auxiliary boiler specially adapted to the purpose, and with an auxiliary steam-engine and water-pump; which said auxiliary engine has also a double connection, so as to take steam either from the main boilers of the ship or from the auxiliary boiler; by means of which combination, fresh water is produced from the main boilers, when these are in use for the purposes of propelling the ship, and then without the necessity of using the auxiliary boiler; and when, by accident or other cause, the main boilers are not in use, the requisite supply of water can be obtained by the use of the auxiliary boilers.

The improvements consist, secondly, in combining with the lower ends of the tubes of the condenser a filter, through which the water shall pass as it is discharged, so that it may be cleansed of such impurities as may have been imparted to it in the apparatus.

At fig. 5, *a*, represents, in side view, a small auxiliary engine, with the valve-gear and other appendages of a direct-action steam-engine. The steam-chest *k*, is connected by a steam-pipe *n*, with the main boiler or boilers of a steam-ship (not exhibited in the drawing); and this steam-pipe *n*, has a branch-pipe *e*, leading to the upper end of the condenser C; and at the junction of the two, the pipe is provided with a four-way or other valve *o*, by which the condenser and the engine can be thrown into communication with, or cut off from, the said boiler or boilers. The steam-chest *k*, is also provided with a branch steam-pipe *l*, *m*, which communicates with an auxiliary steam-boiler A, of any desirable construction. At the point where the steam-pipe *l*, is connected to the steam-chest, it is provided with a stop-cock or valve *r*, for shutting the connection; and at the point where the branches *l*, and *m*, are connected, there is a three-way cock *q*, communicating with a continuation of the part *l*, of the pipe that leads to, and connects with, the main boiler; so that (if desired) steam can be taken from the main boiler when the condenser is not to be used,—as when the auxiliary engine is to be employed for pumping the hold of the ship, or as a fire-engine.

The upper end of the condenser is also connected with the auxiliary boiler by means of a pipe *d*, provided with a stop-cock at *s*; by means of which the connection can be closed when steam is taken from the main boiler. This pipe *d*, is is also provided with a branch *j*, leading to the main boiler; so that steam may be taken from the main boiler when the engine is required to be worked by steam from the main boiler. By means of the arrangements above described, steam for the engine or the condenser may be taken at pleasure, either from the main or the auxiliary boiler. To the outer end of the piston-rod B, of the engine, is attached the piston of a double-acting pump *b*, of any desired construction. From this pump extends a suction-pipe *t*, leading to the outside of the ship; but which may be branched, for the purpose of pumping water from the hold of the ship when required. The pump is also provided with a discharge-pipe *h*, to which hose may be connected when the pump is used as an engine for throwing or forcing water; and the said pipe *h*, is connected with the upper end of the outer case of the condenser by a pipe *f*.

The condenser is composed of an outer case, with tubes inside, in the manner of what is generally known as Hall's condenser. The tubes are arranged in two series; and the steam descends through one series and ascends through the other series. Above the upper end of the second series there is a discharge-pipe *w*, governed by a cock *p*, that may be opened or closed at pleasure. The casing surrounds the two series of tubes; and between the two series there is a partition *v*, which extends from the top to within a short distance of the bottom; so that the cold water, forced in by the pump, circulates around the tubes in the reverse direction of the circulation of the steam through the tubes,—the water being discharged, near the top, through a pipe *g*. At the lower end, the condenser is provided with a filter D, of any desirable construction, having a discharge-pipe *u*, through which the water, resulting from the condensation of steam, is discharged, after having been filtered.

Under the third head of the invention, the patentee claims the double connection of the condenser with an auxiliary boiler and the main boiler or boilers of the ship, as described, in combination with the double connection of the auxiliary engine with the auxiliary boiler and the main boiler or boilers, as described, and for the purpose specified; and also the employment, in the apparatus above described, of a filter in combination with the condenser, for the purpose and in the manner described.—[*Inrolled November*, 1851.]

To Samuel Baxter, *of Wapping, in the county of Middlesex, shipwright, for improvements in apparatus for lifting, and for facilitating the working or steering of ships or vessels.* - [Sealed 12th December, 1850.]

This invention relates to improvements in the construction and working of windlasses or winches.

In Plate IV., fig. 6, is a longitudinal vertical section of the simplest form of winch, adapted to the side of a vessel, for the purpose of assisting in working the sails (such as hauling home the main tack or gallant sheets), or for other purposes for which the apparatus may be applicable. The barrel *a*, *a*, is provided inside with a hollow shaft *c*, *c*, whereby it is mounted on the stud or spindle *b*, *b*, so that it may turn freely thereon. One end of the spindle is made square, and is inserted in a hole, made for that purpose, in one of the side timbers of the ship or vessel. On the inner side of the barrel *a*, *a*, and near the outer end thereof, there is a toothed rack *d*, *d*, into which gears the pinion *e*. To the outer end of the axle of this pinion the crank or winch-handle *f*, for communicating motion to the apparatus, is fixed. The pinion *e*, is mounted in stationary bearings, which are carried by the spindle *b*, *b*. The end of the barrel *a*, *a*, nearest the ship's side, is furnished with ratchet-teeth *g*; and a click or stop-piece *h*, is adapted thereto, for the purpose of retaining the barrel in any particular position. The operation of the apparatus is as follows:—Supposing it is required to haul a sheet taut, the rope of the sheet is first wound two or three times round the barrel *a*, *a*; and then one man, by merely turning the winch-handle, can with ease haul the sheet home in much less time than several men could effect the same operation without the assistance of the apparatus.

The patentee remarks, that to admit of the apparatus being removed to another part of the ship, where it may not generally be required, it is constructed as shewn: to remove it, therefore, it will only be necessary to withdraw the spindle *b*, *b*, from the square hole made in the ship's timbers; and it may then be fitted at any part of the ship, where there is a similar hole to receive the spindle.

Fig. 7, is a longitudinal vertical section of a modification of the winch shewn in fig. 6,—the object being to obtain an increase of power. The barrel is shewn at *a*, *a*, and is mounted on the spindle *b*, *b*, as in the former instance. The winch-handle *f*, is fitted on to the spindle of a worm *i*, in gear with a screw-wheel *j*; the axle of which turns in bearings fixed on the end of the spindle *b*, and carries, at one end, a bevil-pinion in gear with a bevil-wheel *d*, secured to the inner side of the barrel *a*, *a*.

The operation and mode of applying this winch is precisely the same as that before described, and therefore requires no further explanation.

Fig. 8, is a transverse vertical section of a winch for heaving up chain-cables from lockers. In this instance it is made a fixture; but the improved mode of working the same is adapted thereto. Inside the barrel *a*, and at either end thereof, is a circular rack *d*, into which the pinions *e*, *e*, respectively gear; on the outside of the barrel, and at each end thereof, there is a ratchet-wheel *g*, *g*; and clicks or stops *h*, *h*, are attached to the sides of the framing, for the purpose of working therein. Several sets of studs or projecting pieces *k*, *k*, are adapted to the periphery of the barrel *a*, for the purpose of gripping or holding the chain-cables. These studs are so arranged that the links of the chain may lie snugly between them. The axle of the pinions *e*, carries a pair of winch-handles for actuating the apparatus. It will be seen that in this, as well as in the former examples, the position of the clicks or stop-pieces *h*, *h*, may be reversed, to allow the barrel to be worked in either direction. If required, this may be so constructed as to admit of its being removed with facility from one part of the vessel to another. When this is desired, the apparatus is secured to the deck by means of eyes *l**, *l**, which, being fixed in the deck, are made to pass through holes made in the feet of the standards, and are secured therein by passing horizontal pins through the eyes.

At figs. 9, and 10, two of the improved winches (such as that represented at figs. 6,) are shewn as applied to a large stationary ship's winch. In this instance the barrels form part of the stationary apparatus; but, with this exception, their construction and operation is precisely similar to that shewn at fig. 6. Figs. 9, and 10, also exhibit an improved construction of purchase, as applied to a stationary ship's winch; and which may, if required, be also adapted to a windlass. The internal construction and mode of operation of this improved purchase will be best understood by reference to the sectional detached views, figs. 11, and 12. 1, 2, are two rings of ratchet teeth, formed on the periphery of a wheel *l*, *l*, but separated from each other by a T-shaped central division, which runs all round the wheel. The rings are further enclosed by circular side-plates *m*, *m*, whereby they are caused to form the bottom of an annular space. The wheel *l*, is connected to a hollow shaft *n*, which is mounted on the axle B, of the winch, in such a manner as to admit of its being slidden laterally on the same when required. The hollow shaft *n*, is furnished with two prongs *o*, *o*, which, when the purchase is moved laterally on the shaft B, are made to enter between the arms *p*, *p*, of the winch-barrel, and act as a clutch, and thereby carry the same round with the purchase when required. The purchase is made to rotate by the action of the grips *q*, *q*; the ends of which are inserted in the annular spaces, which contain the rings of ratchet teeth 1, and 2; and the opposite ends of these grip-levers *q*, *q*, are connected by means of the rods *r*, *r*, to the ends of a double-armed lever *s*, which is mounted on the horizontal rocking-shaft *t*. At each end of this shaft *t*, a pair of handles *u*, *u*, is mounted, for the purpose of working the purchase, which is effected by alternately raising and depressing the handles *u*, *u*; and, by thus making the shaft *t*, to rock on its axis, the double-arm lever *s*, *s*, will be caused to vibrate, and thereby move the grip-levers *q*, *q*, up and down. It will be seen, upon referring to fig. 12, that the foot of the grip-levers is made with a shoulder; so that, as the lever is raised by the action of the lever *s*, above, the back of the foot will bear against the inner side of the flanges of the T-plate and the side-plates *m*, *m*, and will thrust the toe of the grip-lever against the ratchet teeth, and by that means pull round the purchase and the winch-barrel also (if the latter is connected with it), by means of the clutch. It will be seen, that the grip-levers act alternately; that is, when one is rising and pulling round the barrel, the other lever is descending, in order to take a fresh purchase. It has been already said, that the purchase is mounted loosely on the shaft or axle B, so as to admit of its being slidden laterally thereon, as will be the case when it is required to bring it in gear with the winch-barrel. This lateral motion of the purchase on the shaft *b*, is effected by means of the horizontal lever *v*, (fig. 10,) whereby it may be moved in or out of gear with facility.

When it is required to let a rope run off the winch-barrel, the purchase is thrown out of gear by the lever *v*; and a break-lever *x*, is applied to a break-wheel *y*, on the end of the barrel, in order to prevent it from running round too fast. The patentee shews, in his specification, a modification of the purchase just described,—the principal difference being, that the grip-levers are connected, by means of rods, to cranks on the horizontal shaft *t*. The handles *u*, *u*, are dispensed with; and, in place thereof, a toothed wheel is mounted on each end of the shaft *t*, and driven by pinions on the ends of the barrel of the small winch above: by this arrangement, an increased power is obtained. Motion is communicated through the winch-handles *f*.

Either of the improved winches shewn at figs. 6, and 7, may be employed for working the rudder for steering ships or vessels; for which purpose, it is only necessary to mount the ordinary steering wheel on the axle or spindle of the pinion, in place of the handle *f*, shewn in the drawings; and, in order to protect the gearing inside the barrel *a*, from injury by water or other causes, a water-tight cap-piece is adapted to the outer end of the spindle *b*, so as to cover up the end of the barrel and exclude water therefrom. This cap-piece, being secured to the spindle *b*, is, of course, stationary; and the spindle of the winch-handle *f*, passes through it.

Fig 13, shews an improved kind of whelp, to be applied to windlasses and capstans. The sides of the whelp, as seen from above, are as near as possible parallel; but, in the edge view, the surface of the whelp, for about one-third of its length (that is, from 1, to 2, in the figure), is nearly parallel with the surface of the barrel of the windlass; while from 2, to 3, it is rounded and hollowed out,—this part of the windlass being made round or circular, instead of octagonal. From the point 3, to 4, of the whelp, there is an incline, with concave sides, for the purpose of allowing the chain or cable to "fleet" easily and without jerks, as the hollow or concave side of the inclined parts will have a tendency to hold the cable and prevent it from surging.

The patentee claims, First,—the construction and use of ships' winches, in which motion is communicated to the barrel by means of a pinion or wheel gearing into a rack made on the inner side of the barrel. Secondly,—the improved construction of lever-purchases shewn and described; and particularly the employment of purchases which admit of being moved laterally, so as to be thrown into and out of gear with the barrel of a winch or windlass. He also claims the mode of working or operating purchases, described as a modification of the arrangement shewn at figs. 9, and 10. And, thirdly,—the improved form of whelp shewn and described, or any mere modification thereof.—[*Inrolled June*, 1851.]

To THOMAS HUCKVALE, *of Choice Hill, in the county of Oxford, for improvements in treating mangel-wurzel, and in making drinks and other preparations therefrom.*—[Sealed 2nd April, 1851.]

THIS invention consists in preparing mangel-wurzel in four different ways, so as to obtain products suitable to be mixed with or used instead of coffee, to be employed as a substitute for tea, and to be used for manufacturing fermented liquor and preparing wort.

To prepare a substance which may be combined with or employed in place of coffee, the mangel-wurzel roots are well washed, cut into pieces about the size of peas or beans, and then dried and roasted in the same manner as coffee berries. The product is ground after being roasted; and it is then ready for use.

A substitute for tea is produced by cutting the leaves of mangel-wurzel into small strips or shreds, drying the same, and then placing them upon a hot plate, which is kept at a temperature sufficiently high to slightly char the leaves. The charred mangel-wurzel leaves are to be used in precisely the same way as tea.

To manufacture a fermented liquor, the mangel-wurzel roots are well washed, cut into small pieces, and put into a vat, wherein they are permitted to ferment for two or three days, at a temperature of about 70°, and water is added thereto. A fermented liquor is thus obtained similar to perry or cider.

When the mangel-wurzel roots are to be employed in the preparation of wort, they are washed, and cut into small pieces, which are dried, or slightly charred, by the action of kilns or ovens, of the kind used for drying malt; and wort is prepared from this produce in the same manner as from malt.

The patentee claims, as his invention, the four several modes, above described, of treating mangel-wurzel, and making drinks and other preparations therefrom.—[*Inrolled October*, 1851.]

To FREDERICK PUCKERIDGE, *of Kingsland Place, in the county of Middlesex, merchant, for improvements in the preparation or manufacture of materials or fabrics suitable for ornamenting furniture and other articles.*—[Sealed 17th April, 1851.]

THIS invention consists in covering thin transparent or semi-transparent materials, such as the prepared gut or skins of animals, weazens, bladders, goldbeaters' skin, or other thin membranous materials, either alone or in combination with light fabrics, such as silks, satins, and fine linens, with gold leaf, silver leaf, metal leaf, gold or silver powder, or bronze powders.

The material or fabric, to be covered with the metallic leaf or powder, is prepared or coated with gold size, japanners' gold size, burnish gold size, or other similar or suitable adhesive matter or composition; after which, the gold, silver, or metallic leaf, or the gold, silver, bronze, or other metallic powder, is applied to the prepared surface, and will be found to adhere firmly thereto.

The guts, skins, bladders, weazens, or other thin transparent or semi-transparent membranous parts of animals, so ornamented with gold, silver, or other metallic leaf or powder, may be used alone and employed for ornamental purposes in this state; and may also be spun or twisted into music strings; but if required, the membranous material may, either before or after it is provided with the metallic covering, be attached, by means of size or other suitable adhesive matter or composition, to light woven fabrics, such as silks, satins, fine linens, or similar fine fabrics; and in this state will be found peculiarly applicable for ornamenting curtains and various kinds of furniture, or other articles. The thin membranous material, thus provided with a metallic surface, will, when unattached to woven fabrics, be found to have, on both sides, all the appearance and lustre of the metal with which it is coated; and will possess the further advantage of strength and tenacity, so that the material may be employed for various ornamental purposes, such as for ornamenting various parts of ladies' dress, or other purposes to which it may be applicable.

The patentee does not claim as new the gilding or silvering of leather or other thick materials, that having been long known and in use; but he claims, as his invention, the covering the surface of gold-beaters' skin, gut, bladder, or other thin, translucent or transparent membranous substance or material, with gold, silver, or other metallic leaf;—or gold, silver, or other metallic powder,—so as to impart to the material or substance, thus prepared, the appearance and lustre of real metal; and he claims the application of such prepared membranous substance or material, either alone, or attached to, or in combination with, various thin fabrics, such as silks, satins, linens, or other light fabrics, for ornamenting furniture, articles of dress, or other articles for which it may be applicable.—[*Inrolled October,* 1851.]

To Frederick William East, *of the firm of Thomas East and Son, Bermondsey, leather dressers, for improvements in dressing, embossing, and ornamenting leather.*—[Sealed 15th April, 1851.]

It has been the practice to perform the operations of dressing, embossing, and ornamenting leather on the grain side thereof, or that side from which the hair has been removed. Now, this invention consists in subjecting the flesh side of the leather to these processes, instead of the grain side: whereby, it is stated, a very superior effect is obtained.

The improved mode of operating is applicable to sheep and other skins, tanned with sumach or other common tanning matters, but not to "oil-tanned" skins. The skins are first shaved to a sufficient extent only to remove the flaws, and render them of a uniform thickness; and then they are immersed in water at a temperature of about 120° Fahr., and well brushed on the flesh side, to remove the filth therefrom, and enable the coloring matter to penetrate more readily in the subsequent operation of dyeing. To prevent the dyeing matter coming in contact with the grain side of the skins, they are each folded in half, and the edges sewed together; or two skins, with the grain sides thereof in contact, are sewed together at the edges. The skins, after being thus formed into bags, are subjected to the usual operations of "souring" and "sweetening;" and then they are dyed. The patentee states that the process of dyeing occupies a longer time than when the skins are dyed on the grain side; and he prefers to employ dye liquors of less strength than usual for this purpose, and to repeat the process oftener: whereby the dyeing matter is caused to penetrate more effectually, and a more even color is produced. After the dyeing operation, the skins are rinsed, opened out, and dried; and, when dry, they are "perched" on the flesh side with a knife which is not sharp enough to cut the skin,—the object being to raise a kind of nap on the surface. The skins are again folded with the grain side inwards, and passed through a glutinous solution, composed of one part of size or glaize and three parts of water; or, instead of water, one or two parts of strong dye-liquor may be substituted, when it is desired to obtain deeper shades of color. The skins are next strained on boards to dry; and, when dry, the edges are trimmed, and they are bruised on the flesh side with cork to soften them. In order to perform the operation of embossing, the skins are evenly wetted on the grain side with clean water; and they are then laid with the grain sides of the adjacent skins in contact, and kept closely covered, so as to exclude the air for two or three days. The moisture is thus caused to pass through the leather and act on the glutinous matter, which it thereby renders useful for giving a glossiness and deeper tone of color to those parts of the leather which are subjected to pressure in the embossing process. The embossing is performed on the flesh side of the leather by means of engraved rollers or surfaces, such as are used for embossing velvet, heated to 250° Fahr. The surface of the leather may be further ornamented by sifting pigments or metals in a finely-pulverised state upon it, before the application of the embossing surface; then by the pressure and heat of the embossing surface, the glutinous matter will be caused to fix or retain the pigments or metals on those parts of the surface where pressure is applied; and such pigments or metals may be afterwards dusted off the other parts of the surface. Pigments or metals may also be applied in like manner to the grain side of leather embossed in the ordinary way.

The patentee does not confine himself to the above details, but claims the mode of dressing, embossing, and ornamenting leather above described.—[*Inrolled October*, 1851.]

To Henry Mortlock Ommanney, *of the City of Chester, Esq., for certain improvements in the manufacture of steel.*—[Sealed 19th December, 1850.]

This invention consists in manufacturing steel from iron ores (being oxides of iron) and other oxides of iron deoxidized in the following manner: that is to say, the deoxidizing process is performed in an open furnace, which is so constructed that the charge of ore or oxide and carbon may be introduced at one part, where it is comparatively at a low temperature; then removed, when a suitable time has elapsed, to a hotter part, where it remains for some time; after which, it is removed to a still hotter part of the furnace, and permitted to remain for another period of time; and then it is taken out of the furnace,—the charge being kept stirred during the three stages of the operation.

The reverberatory furnace employed by the patentee is made with three compartments, heated by a fire-place or grate at one end, in the usual manner; and at the other or flue-end of the furnace there is an opening in the roof, fitted with a hopper, whereby the charge is introduced. When the furnace is brought to a proper heat, the compartment nearest the flue-end of the furnace, which is termed No. 1, will be of a black red heat; the next compartment, No. 2, will be somewhat hotter; and No. 3, which is nearest the fire-place, will be of a bright heat. The mixture of ore and carbon (charcoal being preferred) is now introduced through the hopper into the compartment No. 1, and stirred, with the ordinary puddlers' tools, for about an hour and a half; after which, it is turned into No. 2; and then the compartment No. 1, is immediately charged again. After the charge has been stirred in No. 2, for another hour and a half, it is turned into No. 3; then the charge in No. 1, is removed into No. 2; and No. 1, is charged again. The stirring of the charge is continued in No. 3, for another hour and a half; then it is withdrawn through a door at the back of the furnace; and the charge in No. 2, is advanced to No. 3, that in No. 1, to No. 2, and No. 1, is charged again. The process thus goes on continuously,—each charge being worked four hours and a half: which time the patentee has found to be sufficiently long for perfect deoxidation; but he does not confine himself to the same

The deoxidised ore or iron, so removed from the reverberatory furnace, is balled in the puddling furnace in the ordinary way; but, if it is found to have a tendency to form into lumps, the whole is reduced to a powder, by grinding or pounding, and then introduced into the puddling furnace and balled. The balls, on being taken from the furnace, are made into blooms or hammered into casks, plates, or bars; and these are afterwards cut up and converted into steel in the converting furnace; or the requisite degree of carbonisation for steel of any temper may be produced by the addition of charcoal in the crucible or melting operation.

The patentee does not claim the exclusive use of the furnace before described; nor does he confine himself to the above details. He claims the improvement in the manufacture of steel from ores and other oxides of iron deoxidized at successive temperatures, as above described.—[*Inrolled June*, 1851.]

Scientific Notices.

INSTITUTION OF CIVIL ENGINEERS.

November 11, 1851

[*Being the First Ordinary Meeting of the Session.*]

SIR WILLIAM CUBITT, PRESIDENT,—IN THE CHAIR.

THE paper read was, "*An investigation of the strains upon the diagonals of lattice-beams, with the resulting formulæ,*"—by W. T. DOYNE, Assoc. Inst. C.E., and Professor W. B. BLOOD.

The experiments detailed in the paper were made on a model 12 feet in length, so constructed that the diagonals in compression (which were strips of mahogany, let into the top and bottom, but not fastened to them, and the ties, which were of hoop-iron chains) must of necessity take their respective bearing and strain; and by the substitution of a dynamometer for any one of the ties, the strain on it could be accurately measured.

The results of the investigation (which were given in a table, shewing a remarkable coincidence between the strains as measured and calculated) were, that for a parallel beam of one span, supported at each end and loaded at the centre, the strains through-but the diagonals were uniform, and the horizontal strains were greatest at the centre,—decreasing uniformly at the points of support. For a similar beam, uniformly loaded over its entire length, the strains on the diagonals commenced at the centre, increasing uniformly to the points of support; while the horizontal strains decreased from the centre to the ends, in the ratio of the ordinates of a parabola. These results were arrived at by different methods of reasoning; and the formulæ derived from them were stated to be applicable to the more complex form of a closely intersected lattice, taking into consideration the increased number of triangulations.

The paper then proceeded to shew that the same reasoning might be applied to beams with solid sides, and their proportions calculated accordingly.

As a practical illustration of this principle, the author exhibited a drawing of the Glyn Taff viaduct, constructed by him for the Aberdare Iron Company, in which the main bay over the river Taff was 140 feet span, and the weight of ironwork 53 tons. This bridge was capable of carrying a constant load of 73 tons; and the weight necessary to break it was calculated at 359 tons.

In an appendix, the formulæ were extended to the cases of beams fixed at one end only, and also to those having several points of support: in the latter case, it appeared, that the greatest possible strain due to a moving load upon the diagonals at the centre was only one-fourth of that at the points of support, where the bridge was of one span only; and when there was more than one span, that a portion of the value of continuity was lost, in the case of a moving load, in consequence of the point of contrary flexure changing its position.

The paper was illustrated by diagrams, and the experiments upon the model were explained by the author.

November 18, 1851.

The paper read was, "*A description of a new metallic manometer, and other instruments for measuring pressures and temperatures,*"—by M. Eugene Bourdon, of Paris.

In the course of manufacturing a coiled copper worm for a still, one side becoming flattened by accident, internal pressure by a force-pump was applied to restore the cylindrical form; and, to the surprise of the author, as the pressure increased, the coiled tube unwound itself until it became nearly straight. This induced further experiments, which resulted in the production of the various instruments described in the paper, and exhibited to the meeting.

The transverse section of the coil was that of a flattened tube, which, when acted upon internally by the pressure of steam, or any other fluid, had a tendency to uncoil itself as the density increased, and to return to its original form on the pressure being removed. If it was exposed to external pressure, or a partial vacuum was created within it, the tendency of the tube was to coil itself up into a smaller diameter. In the former case, as the tube uncoiled itself, its sides became more convex, and its capacity became greater; and, in the latter instance, the capacity diminished as the sides collapsed and approached each other. It was on this relation between the capacity of the tube, or the amount of convexity of the sides, and the diameter of the coil, that the action of the instrument depended. On bending a flat band of metal round a circle, its transverse form remained unaltered; but by bending a semi-cylindrical or gutter-shaped band into a circular coil, its convexity diminished; and if the circle formed by it were of small diameter, the band became almost flat in the transverse direction. It being, then, a law of general application, that a surface which was curved in two directions could not have its curvature increased in one direction without its curvature being diminished in the other direction, and, *vice versâ,* the action of the instruments in measuring pressure was easily understood.

The variation in the thickness or capacity of a curved flattened tube was shewn by filling the tube with a liquid, and attaching to the centre of its external periphery a small glass tube,—when every change of curvature produced a corresponding motion in the liquid in the tube; for as the tube was straightened, its capacity increased, and as it curled up again, it diminished. The change in the thickness or capacity of the tube being proportional to the variation of its radius of curvature, it was found, by experiment, that the motion of the extremities of the tube was in proportion to the pressure applied; so that the indications were equal for equal increments of pressure: this fact greatly facilitated the construction of the indicating instruments.

The simplest form exhibited was that of the steam-pressure gauge, in which rather more than one convolution of flattened tube was employed,—one end being attached to a stop-cock in connection with the boiler, and the other extremity carrying an index-pointer, which traversed a scale graduated to given pressures per square inch: on the steam being admitted, the tube uncoiled, and the pointer indicated the amount of pressure to which it was subjected. When a greater range of motion was required, the lever, instead of being placed on the axis of the index, carried a toothed segment, which, working into a pinion on the spindle of the index, increased the extent of indication. This arrangement was adapted for barometers, in the construction of which the air was exhausted from the flattened tube, which was then hermetically sealed. The pressure of the atmosphere acted on the exterior, and was balanced by the elasticity of the tube, which varied in curvature with every variation in the pressure of the atmosphere.

Many ingenious modifications of the principle, and adaptations of it to various purposes, were described. The construction of thermometers, by a spiral flattened tube, was extremely novel and good;—that, also, of a pyrometer, for measuring high temperatures, was equally clever. The steam-engine indicator was simple in construction, and avoided the error which has to be allowed for in the ordinary instrument.

The instruments were stated to be very generally adopted in France, where the government inspectors of steam-engines used pressure gauges on this principle in verifying the accuracy of all the other instruments they found attached to the engines under their inspection. At the French Exposition of 1849, M. Bourdon received a gold medal; and at the Great Exhibition in Hyde Park he was rewarded by a Council medal.

Mr. POLE, Assoc. Inst. C.E., exhibited and explained an instrument of his invention, called *the "prismatic clinometer," for measuring angles of elevation and depression.* It was an application to vertical angles of the principle of Captain Kater's prismatic compass, in which the angle is read by a prism, at the same time that the sights are directed to the object. The advantages of Mr. Pole's instrument were, its portability (it being only about three inches in diameter, and three-quarters of an inch thick); its simplicity, durability, and safety in carriage; the convenience and facility with which it could be used; and its accuracy. The various applications of the instrument were explained, and also a modification of its construction, by which it could be combined with the prismatic compass, and a new compound instrument thereby produced, which would be exceedingly useful in topographical investigations.

Mr. C. MAY, M. Inst. C.E., directed the attention of the meeting to some specimens of iron ore, now being extensively raised in the neighbourhood of Middlesbro'-on-Tees, by which as great a revolution would, probably, be caused in the iron trade of the North of England as the discovery of the black band ore in Scotland had produced some years since. This ore was found in a bed of 15 feet in thickness, close to the surface, amidst cheap fuel, and within a few miles of a seaport; and as it contained from 30 to 35 per cent. of iron, its advantages were already so fully estimated by the proprietors of some iron works, where there were eleven blast furnaces, that they had ceased working their former mines—finding it more advantageous to convey this ore to their works (a distance of fifty-five miles) by railway.

INSTITUTION OF MECHANICAL ENGINEERS, BIRMINGHAM.

A SLATE, Esq., Vice-President,—in the Chair.

October 22nd, 1851.

After the transaction of certain routine business, the following paper was read by Mr. J. A. Shipton, of Manchester:—

On the direct conversion of rectilinear into circular motion in the steam engine.

The present paper brings under notice a steam engine, not deviating in principle from the ordinary reciprocating engine, but simply in its construction. In the ordinary reciprocating engine, although the whole area of the piston be exposed to the pressure of the steam throughout the stroke (supposing the valve be kept open), there are certain points where this pressure is useless: namely, when the crank is on the centre. The circular motion of the crank restricts the piston from exerting its full force with regard to that circular motion; and thereby the velocity of the piston is constantly varying throughout the stroke, as also the power exerted and the steam consumed in like propertion: thus the actual power exerted is the average velocity of the piston multiplied by the pressure. Now, an excentric being a mechanical equivalent for a crank,—if the area of the piston of one engine be equal to the area of the piston of another, and the throw of the excentric (which is substituted for the crank in the second engine) be equal to the stroke of the crank in the first engine, they are of like power. Then, by altering the mechanical arrangement, and placing a piston at top and bottom of the excentric, or, in other words, placing the excentric in a large piston (within the steam cylinder), the area of piston and throw of excentric being the same as in the second engine, an engine of like power is obtained. Therefore the crank, the excentric, and the excentric within the piston, are equivalents of each other, differing only in mechanical construction; and the power obtained from each would be the same,—not taking friction into consideration. Dispense with the pistons in the last arrangement, and admit steam alternately at top and bottom of the cylinder; the excentric or excentric piston would then be propelled up and down in a rectilinear direction; and this motion would be converted into a circular motion, during the propulsion of the piston. Here is obtained the amalgamation of the two motions of the ordinary engine in one body;—the same body containing the properties of the reciprocating piston, and also of the crank.

The practical application of this principle is effected in the pendulous engine, which is a modification of an engine that was submitted by the author to a former meeting of the Institution.* The pendulous engine consists of a base plate, whereon two side frames are bolted; and these frames carry bearings at the top, to receive the hollow trunnions of the cylinder, which is formed with semicircular ends, and swings with a pendulous action between the side frames. The piston is turned perfectly true, having the main shaft extending through and keyed excentric in it. This shaft works in pedestals, which are fixed on the bed-plate. The piston works between two parallel surfaces, as in the former engine,—one being a plate dove-tailed into the cylinder, and the other being a plate which is fitted into a recess, and so arranged that, by means of adjusting screws, it is moved forward to compensate for any wear that may take place on the periphery of the piston, and maintain a steam-tight joint. The piston is packed at the ends with conical rings, fitted into a conical seating; and as wear takes place, they are sprung open by means of a small wedge and bolt, inserted where the ring is cut open, to allow it to expand. These rings work against the side plates of the cylinder. Steam is admitted precisely the same way as in an ordinary engine, at top and bottom of the piston; but the valve is on the equilibrium principle, and exhausts through the back,—being packed by a conical ring, in a similar manner to the ends of the piston. The valve is worked from an excentric on the main shaft, by means of levers and a weigh-shaft. The steam and exhaust pipes are inserted into the ends of the hollow trunnions, and are packed with glands, to admit of the pendulous motion of the cylinder. The distances between the centres are calculated so as to allow the pendulous motion of the cylinder to coincide with the rate of revolution of the engine, and, consequently, only a small portion of the weight of the moving body has to be overcome, with respect to the vibration.

The advantages of this engine are,—economy in first cost, in space, and in foundations (being self-contained),—simplicity and economy in repairs, as the wearing parts are insertions, and may be renewed at a short notice,—direct application of the steam to produce the rotary motion of the shaft, without the intervention of joints or connecting rods,—and the absence of liability to derangement, as the moving parts are so few in number. As it contains less frictional surface than the ordinary engine, economy in consumption of fuel may be expected. High speed may be obtained; and thus gearing, wheel-work, &c., may be dispensed with. From its compactness, this engine is most suitable for working the heavy class of machinery, such as rolling-mills, &c., or screw-propellers in steam-boats.

Mr. Shipton exhibited a working model of the pendulous engine, and illustrated its action by sectional models.

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* For description of this engine, see Vol. XXXVII. of our present series, p. 207.

Mr. Elwell enquired whether a similar engine had not been at work for a considerable time at Wolverhampton? and what was the probable cost of such engines?

Mr. Shipton replied, that the engine at Wolverhampton was constructed on the former modification of the plan, in which the piston oscillated instead of the cylinder. The cost would be £9 per horse-power, exclusive of the boilers. The only comparative trial that had yet been made, as to the consumption of fuel, was with an engine at Manchester, which showed a saving of 10½ per cent., as compared with another direct-acting engine which worked from the same boiler.

Mr. Clift observed, that Mr. Shipton had argued that a considerable saving would be effected by avoiding the crank motion and the reciprocation of the piston; but he had against that the whole weight of the cylinder in motion, which was a large weight to be stopped and reversed at every revolution; and therefore he could not see what advantage the invention possessed over the ordinary engines.

Mr. Shipton replied, that the pendulous motion of the cylinder prevented the loss of power in reciprocation: the cylinder vibrated as a pendulum; and they found that one man could work the cylinder of a 20-horse engine in vibration, at full speed.

Mr. Clift inquired whether the cylinder was made of correct length to vibrate, according to the law of a pendulum, at the actual working speed of the engine? as, if not correctly adjusted, it might require a large amount of power to force it into the required rate of vibration.

Mr. Shipton said, the remark would apply to all oscillating engines; but in this engine they had calculated the length of the centres of oscillation, so as to agree with the intended rate of working of the engine.

Mr. Siemens observed, that weight was certainly of secondary consideration, if the centre of oscillation could be made to agree with the corresponding length of pendulum; and such an arrangement would make the power more uniform throughout the stroke. But it would not be correct to consider the weight of the piston as a loss, in a reciprocating engine; as the momentum was gradually absorbed by means of the crank, and given out again in starting the return stroke. In some cases a heavy weight of piston and connecting rod was actually an advantage;—an expansive engine, cutting off at half stroke, worked more steadily with a heavy connecting rod than with a light one, as it absorbed surplus power at one part of the stroke, and gave it out again when the moving power was deficient,—tending to equalize the power. With respect to Mr. Shipton's engine, he considered the question to be one of comparative friction, compactness, and simplicity.

The following paper, by Mr. J. E. Clift, of Birmingham, was then read:—

On the preservation of timber by creosote.

Wood may be briefly stated to be composed of a fibrous tissue, which, upon examination with the microscope, is found to consist of longitudinal tubes, arranged in concentric rings around the centre pith;—these tubes varying in diameter from $\frac{1}{1000}$th to $\frac{1}{100}$th part of an inch. The use of these tubes in a growing tree is to convey the sap from the root to the branches; and after the tree is cut up for for use, they contain the chief constituent of the sap, vegetable albumen—a substance very much resembling in its composition animal albumen, or the white of an egg. Different woods vary in the proportion which they contain of this substance; but in the softer woods it averages one per cent.

The dry-rot in timber is caused by the putrefaction of the vegetable albumen, to which change there is a great tendency; and when once this has taken place, it soon infects the woody fibre, inducing decomposition, and causing its entire destruction. Many plans have been employed to arrest this evil, each with more or less success,—the chief aim of the authors being to coagulate the albumen by means of metallic salts, and so prevent putrefaction. Among others may be mentioned the following, as being the most successful:—Kyan's process, by the use of chloride of mercury; Burnett's, by chloride of zinc; and Payne's, by sulphate of iron and muriate of lime, forming an insoluble precipitate in the pores of the wood. To each of these plans there are serious objections in practice. In the first place, when metallic salts are injected into timber in sufficient quantities to crystallize, the crystals force open the pores, causing a disruption of the fibre; and when the timber afterwards becomes wet, they dissolve, leaving large spaces for the lodgment of water, and rendering the timber much weaker. Secondly, the metallic salts being incapable of sealing the pores of the wood, the fibre is still exposed to the action called eremacausis—a process of oxidation—after the albumen has been precipitated. These processes are also objectionable for wood that requires iron to be inserted in or attached to it, as the acids act upon the iron in a manner well known, and ultimately destroy it.

The plan that is the subject of the present paper is the one invented by Mr. Bethell, for the use of a material obtained by the distillation of coal tar. This material consists of a series of bituminous oils, combined with a portion of creosote: which latter substance is acknowledged to possess the most powerful antiseptic properties. The action of the material may be thus described:—When injected into a piece of wood, the creosote coagulates the albumen, thus preventing the putrefactive decomposition; and the bituminous oils enter the whole of the capillary tubes, encasing the woody fibre as with a shield, and closing up the whole of the pores, so as entirely to exclude both water and air. The bituminous oils being insoluble in water, and unaffected by air, the process is thereby rendered applicable to any situation. So little is bituminous oil affected by atmospheric change, that the writer has seen wrought-iron pipes that had merely been painted over with it, and laid in a light ground, one foot beneath the surface, taken up after twenty years, and they appeared and smelt then as fresh as when first laid down.

By using these bituminous oils, the most inferior timber, and that which would otherwise soonest decay (from being more porous, and containing more sap, or being cut too young, or at the wrong season) is rendered the most durable. This will be readily understood when it is considered that this porous wood will absorb a larger portion of the preserving material than the more close and hard woods: in fact, the soft woods are rendered hard by this process. By this means, therefore, engineers will be enabled to use a cheaper timber with greater advantage than they could use a more expensive timber uncreosoted: thus, taking the cost of a sleeper of American yellow pine at 4*s*., and one of Scotch fir at 3*s*., and then adding 1*s*. to the latter for creosoting, the two would be the same cost; but the former one would last, under the most favorable circumstances, not more than ten or twelve years; and the other would be good, under any circumstances, in all probability in a hundred years.

This system of preserving timber has been in use on several railways, and other works, for several years past. A portion of the London and North Western Railway, about seventeen miles in length, has been laid with the creosoted sleepers from nine to eleven years: during which period the engineer reports that no instance has occurred in which any decay has been detected in them, and they continue quite as sound as when first put down. On the Stockton and Darlington Railway, creosoted sleepers have also been laid for ten years, and are found to continue without any appearance of change or decay; also, on the Lancashire and Yorkshire Railway creosoted timber has been used for five years, as paving blocks, posts, &c.: the upper part has become very hard, and the part under ground appears as fresh as when taken out of the creosote tank, though the timber was of inferior, sappy quality. In a trial, commenced twelve years since, by Mr. Price, of Gloucester, of the comparative durability of timber in the covers of a melon-pit, where it was exposed constantly to the combined action of decomposing matter and the atmosphere, the unprepared timber became decayed in one year, and required replacing in a few years; a portion of the timber that had been Kyanized lasted well for about seven years, but then very slowly decayed; while the timber that had been creosoted still continues as sound as when first put down.

Not only does this creosoting process render wood free from decay, but it also preserves it from the attacks of the teredo worm, when used for ship-building, harbours, docks, and other work contiguous to the sea. This has been satisfactorily proved at Lowestoft harbour, where the plan has had a very extensive trial for four years; and the superintendent reports that the uncreosoted piles have all been attacked by the limnoria and the teredo to a very great extent, and in some instances are eaten through; but there is no instance whatever of a creosoted pile being touched, either by the teredo or the limnoria; and all the creosoted piles are quite sound, though covered with vegetation, which generally attracts the teredo. This is to be accounted for by the creosote remaining intact in the timber, either wet or dry; and, being destructive to all animal life, it is proof against the attack of these parasites; whereas, with the other processes, the metallic salts are washed out,—or that portion which unites with and coagulates the albumen is rendered quite innocuous by the process.

There are two processes in use by Mr. Bethell, for impregnating timber with creosote. One is by placing the wood in a strong iron cylinder, and exhausting the air from it, by an air-pump, until a vacuum is created, equal to about twelve pounds on the square inch; the creosote is then allowed to flow into the cylinder, and afterwards a pressure is put upon the creosote, by a force-pump, equal to about 150 pounds on the square inch; and the timber, on being taken out, is fit for use.

The second process consists in first placing the timber in a drying-house, and passing the products of combustion through it: thereby not only drying the timber rapidly, but impregnating it, to a certain extent, with the volatile oily matter and creosote contained in the products given off from the fuel used to heat the house. When the timber is taken out of this house, it is at once immersed in hot creosote in an open tank,—thus avoiding the use of a steam-engine, or pumps.

Mr. Clift exhibited specimens of creosoted sleepers, which had been in use for ten years on the London and North Western Railway, near Manchester, and were still perfectly sound and unchanged; also specimens of creosoted piles from Lowestoft Harbour, which had been in the sea for four years, and continued quite fresh and sound, and without being touched by the worm; and specimens of similar piles, uncreosoted, from the same situation, which were completely eaten away and honeycombed by the worm in the same period.

Mr. Bethell observed, that when he first began to preserve timber, he found that no pressure would get the creosote into it, owing to the pressure of moisture in the pores; it therefore became necessary to adopt the system of drying the timber first; and, after fourteen days, he found that the wood lost 3 lbs. in weight in every cubic foot: this was by the old process of drying. He then introduced the present drying-house; and, in twelve or fourteen hours, they lost 8 lbs. per cubic foot, in Scotch sleepers, which then absorbed an equal weight of creosote. An average of 11½ lbs of creosote per cubic foot was now put into all the Memel timber at Leith harbour works; and it was forced in with a pressure of 180 lbs per inch. One piece of creosoted timber had been observed at Lowestoft, which had been half cut through for a mortice, but not filled up again, and a teredo had penetrated a little way into it at that part, and then attempted to turn to the right, and then to the left, and had ultimately quitted the timber without proceeding any farther. Young wood was the most porous round the exterior, and, consequently, absorbed most creosote, which formed a shield to keep off the worm. The creosoted sleepers were better, after eight or ten years, than when new; because the creosote got consolidated in them, and rendered them harder. He had taken the idea originally from the Egyptian mummy; it was exactly the same process;—any animal put into a creosote tank assumed the appearance and became in like condition to a mummy. Timber creosoted was now chiefly used in railways; but he believed that, if it was introduced into coal pits, it would be found that no timber so used in those places would rot.

The Chairman inquired whether, in the process of creosoting, the quantity of sap was calculated, and how the exact quantity of creosote that was put into the timber was ascertained.

Mr. Bethell replied, that every piece of timber was weighed before it was put into the creosote tank, and again when taken out; and each piece was required to be increased in weight, by the process, 10 lbs. per cubic foot. The quantity of oil used always rather exceeded the weight gained in the timber, on account of the loss of weight from the moisture extracted by the exhaustion of the air-pump. He also remarked, in answer to another question from the Chairman, that oak only absorbed half as much creosote as Memel timber. Common fir creosoted would last double the time of hard wood creosoted, because it took more creosote. Beech made the best wood, being full of very minute pores; and they could force a greater quantity of creosote into beech than into any other wood: consequently it took a more uniform color throughout from the process. Long pieces of timber were found to require more time to saturate them in proportion to their length. The creosote appeared to enter at the two ends, and be forced up through the whole length of the pores; and the progress was known by the quantity of creosote forced into the tank after it was filled, according to the number of cubic feet of timber contained in the tank.

Scientific Adjudication.

COURT OF CHANCERY.

Before the Master of the Rolls,

20th Nov., 1851.

MITCHELL *v.* BARBER.

Mr. Lloyd, Q.C., and Mr. Hardy, were council for the plaintiff; and Mr. Walpole, Q.C., and Mr. Surrage for the defendant.

The plaintiff filed his bill in July last, and now applied, by motion, for an injunction to restrain the defendant, Mr. Harby Barber, from an alleged infringement of a patent granted on the 24th of February, 1844, to Benjamin Bailey, "for improvements in machinery for manufacturing looped fabrics;" of which patent the plaintiff was the assignee. The invention claimed in the specification, as appeared from the affidavits of the plaintiff, and of Bailey the original patentee, in which it is set forth, was stated to be for a "novel mode of constructing and working what is called the presser-bar of machinery used in making looped fabrics. The presser-bar, as heretofore, works in front of the sinkers; but is so arranged, that a very short length of movement is required; and, at the same time, parts of the presser-bar are at all times between the sinkers, and, in fact, guide and protect the sinkers from bending laterally; and it is these particulars of constructing and working of presser-bars of machinery for making looped fabrics, that constitute the improvements secured under the letters patent. The presser-bar is divided into as many parts as there are sinkers, and so that one of the parts enters and constantly works between two neighbouring sinkers; whereby, on the one hand, the presser for each needle is guided in its work by the sinkers, and the sinkers are sustained and guided by the pressers,—which will be found very important when working quickly; and, owing to the shortness of the motion required to the presser-bar, aided by the mutual guiding and supporting of the pressers and the sinkers, the speed of the frame may be quickened with safety."

The merits of the invention, therefore, consisted in the division of the presser-bar into separate parts, called presser-bits; the mutual guidance and support afforded by these and the sinkers to each other, derived from the retention of the presser-bits between the sinkers; and the shortness of stroke required for the presser-bar.

The plaintiff's case was further supported by the affidavits of workmen, shewing that the defendant's machines were fitted with presser-bits similar to, and working on the same principle, as those of the plaintiff.

The defendant's answer to the case was, that the alleged improvements, described in Bailey's specification, presented no novelty of invention—that, prior to the date of his patent, the mode had been introduced, of pressing the needles by means of presser-bits or coverers, attached to the presser-bar at points corresponding with the number and position of the needles, and working between, and supporting and guiding, the sinkers. By the evidence filed in support of the defendant's case, it was shewn that, prior to the date of the patent, the defendant had applied to his machines the precise principles of construction and mutual guidance now claimed; and that, in the year 1841, Messrs. Cartwright, Warner, and Haywood, of Loughboro', obtained letters patent for certain improvements connected with stocking-frames; and that their specification and drawings described and delineated presser-bits precisely similar to those used by the defendant, and identical, in their mode of construction and working, with those shewn and described in Bailey's specification and drawings. It also appeared that Messrs. Cartwright and Co., at the time of obtaining their patent, had abandoned their original intention of claiming, generally, the application of presser-bits working between the sinkers, in consequence of discovering that they had previously been in use; and they confined their claim to the combination of that principle with another, which was included in their patent. The same reason induced them to abandon certain complaints which they addressed to the plaintiff in 1843,—that, by using the presser-bits, described and patented by him, he was invading their rights, and using their patent. The defendant's allegation of the want of novelty in Bailey's invention was also supported by the affidavits of several workmen and machine-makers,—stating that, prior to the date of his patent, the mode of pressing down the beards of needles by means of presser-bits or coverers, working between the sinkers, was known and used by them; and that presser-bits, of various shapes and lengths, had been in use many years, differing in no material respect from those of the plaintiff's, except in such alteration of their shape as might be necessary to adapt them to their position on the frame, and their connection with those parts through which they were actuated,—the only essential requirement being, that their extremities should press upon the right part of the beards of the needles.

The plaintiff replied to this case by drawing a distinction between presser-bits and coverers. Affidavits in reply were filed by him, alleging that, in 1837, a patent was obtained by Joseph Mather, of Nottingham, for a machine for manufacturing looped fabrics, which worked by means of coverers, which were alleged to be altogether unlike, and essentially different from, the presser-bits used by Bailey; inasmuch as the coverers were long pieces of thin sheet-iron, covering the entire length of the needles, fixed on a spindle-bar at the back of the sinkers, and projecting through the sinkers; whereas, Bailey's presser-bits were only bits of rolled wire, fixed on a moveable bar on the face of the frame, and working between, and to and fro, with the sinkers, and covering only part of the beards of the needles. The plaintiff contended, that all the evidence adduced by the defendant, impugning the novelty of Bailey's invention, referred to the previous use of Mather's coverers; and therefore to a principle, and mode of construction and working, essentially different from his.

The specifications of the three before-mentioned inventions were then examined, on behalf of the defendant, by Mr. A. V. Newton, patent agent, from whose affidavit it appeared, that Messrs. Cartwright, Warner, and Haywood's patent described two modes of depressing the beards of the needles by pressers which are at all times between the sinkers; for, in one case, they were, in fact, pieces of metal, rivetted to and projecting from the sides of the sinkers; and, in the other, they consisted of a series of pressers, free of the sinkers, but interposed and acting between them. The result of the comparison of Bailey's specification with that enrolled by Mather was stated to be, that the invention of the latter possessed precisely the same advantages as Bailey's, viz., the working of the pressers between the sinkers, and the mutual guiding and supporting of the pressers and sinkers; and that his pressers, as far as their arrangement was concerned, differed from the plaintiff's merely in this,—that, while Bailey's were attached to a presser-bar, placed in front of the needles, those of Mather projected from a bar behind the needles, for the purpose of being thereby brought more conveniently into connection with a Jacquard apparatus, for working a pattern on the knitted fabric.

Mr. Carpmael, patent agent, filed an affidavit for the plaintiff, in reply to Mr. Newton's, to shew that Messrs. Cartwright, Warner, and Haywood's invention materially differed from Bailey's, "because it was essential to the latter that the presser-bar and pressers should be and act from the front;" that the latter was also the very reverse of Mather's, inasmuch as the latter claims the arrangement of pressers so as to work from the back; the effect of which was, to render them long and inconvenient in their motion;—whereas, by the position of Bailey's pressers in front, the advantages were gained of shortness in the stems and motion of the pressers, and consequent increase of speed in working the machine.

With respect to the manner of communicating motion to the presser-bar, it appeared that there was no similarity between the machines of the plaintiff and defendant; nor, in fact, that the mode used by Bailey, though particularized in his specification, was claimed as part of his invention. He describes his presser-bar as being carried by two arms, affixed to the ends of the carriage, and moving to and fro with the working parts. At each end is a spring, supporting the presser-bar and parts connected therewith; and, at each end of the presser-bar, is a connecting-rod, attached to an arm affixed to a spindle-bar; and, on the arm, is a truck or roller, which bears against a cam, keyed to the driving-shaft of the machine. All these parts are delineated in the drawings to which references are made, and are stated in the specification to be "similar to those employed in like machines,—they being only varied to adapt them to the movements required for the novel mode of constructing and working the presser-bar," which is then described in the words already quoted.

It appeared that no part of the machinery, described above, was required in the defendant's frame, in which the presser-bar is attached to the hanging-cheek, and therefore derives its motion from the same power which regulates the motion of the sinkers. This arrangement, the defendant maintained, afforded several advantages,—as, by dispensing with the cumbrous machinery described above, and the independent motion and consequent vibration of the presser-bar, that bar could be made lighter and placed nearer to the sinkers: whereby greater speed in working, more room for additional machinery, and freedom from obstruction to the workman, were secured.

After reading the affidavits, the Master of the Rolls declined to decide upon evidence so contradictory. He refused to grant the plaintiff an injunction; but directed him to bring an action at law against the defendant, to try the disputed question at the ensuing Spring Assizes,—the defendant, in the meantime, undertaking to keep an account of the profits made by the working of his machines, constructed on the principle, the use of which was complained of as an infringement.

List of Patents

That have passed the Great Seal of IRELAND, from the 17th September to the 17th November, 1851, inclusive.

To Samuel Holt, of Stockport, in the county of Chester, manager, for certain improvements in the manufacture of textile fabrics. —Sealed 24th September.

Henry Wimshurst, of Broad-street, Ratcliff-cross, in the county of Middlesex, ship builder, for improvements in steam-engines, in propelling, and in the construction of ships and vessels.—Sealed 30th September.

Charles Hardy, of Low Moor, in the county of York, engineer, for certain improvements in the manufacture of scythes,—being a foreign communication.—Sealed 6th October.

Peter Robert Drummond, of Perth, for improvements in churns. —Sealed 20th October.

James Webster, of Leicester, engineer, for improvements in the construction and means of applying carriage and certain other springs.—Sealed 3rd November.

Robert Oxland and John Oxland, both of Plymouth, chemists, for improvements in the manufacture and refining of sugar.—Sealed 3rd November.

Alexis Delemer, of Radcliffe, in the county of Lancaster, civil engineer and machinist, for certain improvements in the application of coloring matter to linens, cottons, silks, woollen, and other fabrics; and to linen, cotton, silk, woollen, and other weft; and also in machinery or apparatus for those purposes.—Sealed 5th November.

List of Patents

Granted for SCOTLAND, subsequent to 22nd September, 1851.

To John MacDowall, of Walkenshaw Foundry, Johnstone, Renfrewshire, engineer, for improvements in cutting wood and other substances, and in the machinery or apparatus employed therein; and in the application of the power to the same.—Sealed 22nd September.

Henrietta Brown, of Long-lane, Bermondsey, widow and executrix of the late Samuel Brown, for improvements in the manufacture of metallic casks and vessels,—being a communication. —Sealed 24th September.

Leman Baker Pitcher, of Syracuse, State of New York, for improvements in apparatus for regulating motive power engines.—Sealed 24th September.

Robert Newell, of the City of New York, lock manufacturer, for certain new and useful improvements in the construction of locks —Sealed 24th September.

John Wormald, of Manchester, maker-up and packer, for improvements in machinery or apparatus for spinning and doubling cotton, wool, silk, flax, and other fibrous substances.—Sealed 29th September.

Charles Watt, of Kennington, Surrey, chemist, for improvements in the decomposing of saline and other substances, and separating their component parts, or some of them, from each other; also in the forming of certain compounds or combinations of substances; and also in the separating of metals from each other, and in freeing them from impurities.—Sealed 29th September.

Thomas Kennedy, of Kilmarnock, gun manufacturer, for improvements in measuring and registering the flow of water and other fluids.—Sealed 29th September.

Elijah Galloway, of Southampton-buildings, London, civil engineer, for improvements in steam-engines.—Sealed 30th September.

William Johnson, of Millbank, Westminster, London, for improvements in ascertaining the weight of goods.—Sealed 1st October.

William Barker, of Hulme, near Manchester, millwright, for improvements in machinery for chipping, rasping, and shaving dyewood and other materials, and in apparatus connected therewith.—Sealed 6th October.

Henry Curzon, of Kidderminster, civil engineer, for improvements in the manufacture of carpets and rugs.—Sealed 10th October.

Thomas Lightfoot, of Jarrow Paper Mills, South Shields, paper manufacturer, for improvements in machinery applicable to the manufacture of paper.—Sealed 10th October.

George Robbins Booth, of Portland-place, Wandsworth-road, Surrey, for improvements in generating and applying heat.—Sealed 15th October.

William Onions, of Southwark, Surrey, engineer, for improvements in the manufacture of steel.—Sealed 15th October.

Henry John Betjemann, of Upper Ashby-street, Northampton-square, London, for improvements in connecting parts of bedsteads and other frames, and in machinery employed therein.—Sealed 16th October.

Daniel Dalton, of Spon-lane, parish of Westbromwich, Staffordshire, iron-founder, for improvements applicable to railways.—Sealed 16th October.

William Jules Varillat, of Rouen, France, manufacturer, for improvements in the extraction and preparation of coloring, tanning, and saccharine matters, from various vegetable substances, and in the apparatus to be used therein.—Sealed 20th October.

William Onions, of Southwark, Surrey, engineer, for improvements in the manufacture of nuts and bolts; also of steps, bearings, axles, and bushes; also of mills, and dies for engravers; also of bells, lathe and other spindles; also of weft forks, shuttle tongues, and lifts for looms; also parts of agricultural implements, churns, roller guides, and throstle bars, by the application of materials not hitherto used for these purposes.—Sealed 20th October.

Thomas Sanders Bale, of Cauldon-place, in the county of Stafford, china manufacturer, for certain improvements in the method of heating, ornamenting, and preserving buildings and edifices; which said improvements are also applicable to other similar purposes.—Sealed 20th October.

Robert Griffiths, of Havre, engineer, for improvements in steam-engines, and in propelling vessels.—Sealed 21st October.

Frederick William Mowbray, of Leicester, for improvements in machinery for weaving.—Sealed 21st October.

William Fawcett, of Kidderminster, for certain improvements in the manufacture of carpets.—Sealed 21st October.

Donald Henderson, of Glasgow, ironmonger, for an improved apparatus for generating gas; which apparatus may be used for heating and other similar useful purposes; and other apparatus for heating and ventilating.—Sealed 22nd October.

George Fergusson Wilson, of Vauxhall, Managing Director of Price's Patent Candle Company; David Wilson, of Wandsworth; James Childs, of Putney; and John Jackson, of Vauxhall, Surrey, for improvements in presses and melting, and in the process and apparatus for treating fatty and oily matters; and in the manufacture of candles and night lights.—Sealed 22nd October.

Edwin Deely and Richard Mountford Deely, of Andnam Bank, Staffordshire, flint and bottle-glass manufacturers, for improvements in the construction of furnaces for the manufacture of glass.—Sealed 31st October.

Alfred Vincent Newton, of the Office for Patents, 66, Chancery-lane, London, mechanical draughtsman, for certain improvements in the construction of railways,—being a communication.—Sealed 4th November.

William Smith, of Upper Grove Cottages, Holloway, engineer, for improvements in locomotive and other engines, and in carriages used on railways.—Sealed 4th November.

Robert Hyde Grey, of Manchester, manufacturer and merchant, for certain improvements in machinery or apparatus for manufacturing weavers' healds or harness,—being a communication.—Sealed 4th November.

Michael Scott, of John-street, Adelphi, London, civil engineer, for improvements in punching, rivetting, bending, and shearing metals, and in building ships.—Sealed 5th November.

Benjamin Hallewell, of Leeds, wine merchant, for improvements in drying malt.—Sealed 5th November.

Matthew Gibson, of Wellington-terrace, Newcastle-upon-Tyne, for improvements in machinery for pulverizing and preparing land.—Sealed 7th November.

William Longmaid, of Beaumont-square, London, for improvements in treating ores and minerals, and in obtaining various products therefrom,—certain parts of which improvements are applicable to the manufacture of alkali.—Sealed 7th November.

Antoine Dominique Sisco, of Slough, for improvements in the manufacture of chains, and in combining iron with other metal, applicable to such and other manufactures.—Sealed 7th November.

Frederick Joseph Bramwell, of Millwall, London, engineer, for improvements in working the valves of steam-engines, for marine and other purposes, and paddle-wheels.—Sealed 12th November.

Henry Lund, of the Temple, London, for improvements in propelling.—Sealed 12th November.

William Boggett, of St. Martin's-lane, and George Holworthy Palmer, of Westbourne Villas, Paddington, civil engineer, for improvements in obtaining and applying heat and light.—Sealed 14th November.

Henry Richardson, of Aber Hourant Bala, North Wales, for certain improvements in life-boats (going over again).—Sealed 14th November.

James Bagster Lyall, of No. 45, Thurloe-square, Brompton, London, for an improved construction of public carriages.—Sealed 14th November.

James Pyke, of Westbourne-grove, Bayswater, London, for improvements in the manufacture of leather; also in making boots and shoes.—Sealed 17th November.

Hugh Bowlsby Willson, of the York Hotel, Blackfriars, London, for improvements in the construction of rails for railways,—being a communication.—Sealed 19th November.

George Tate, of Bawtry, Yorkshire, for improvements in the construction of dwelling houses and other buildings, including carriages and floating vessels; and in the propulsion of such vessels; and in the adaptation and manufacture of materials for such uses.—Sealed 21st November.

New Patents

SEALED IN ENGLAND.

1851.

To Thomas Greenwood, machinist, and James Warburton, worsted spinner, both of Leeds, in the county of York, for certain improvements in machinery for drawing and combing wool, silk, flax, hemp, and tow. Sealed 3rd November—6 months for inrolment.

George Fergusson Wilson, managing director of Price's Patent Candle Company, Vauxhall; David Wilson, of Wandsworth, Esq.; James Childs, of Putney, Esq.; and John Jackson, of Vauxhall, aforesaid, Gent.; all in the county of Surrey,—for improvements in presses and matting; and in the process of, and apparatus for, treating fatty and oily matters, and in the manufacture of candles and night-lights. Sealed 3rd November—6 months for inrolment.

François Marie Lanoa, of Paris, for improvements in apparatus for holding and drawing off aerated liquors, and in machinery for filling vessels with aerated liquors. Sealed 3rd November—6 months for inrolment.

Henry Vigurs, of Camden-town, in the county of Middlesex, engineer, for improvements in buffers, grease-boxes, axle-boxes, and springs, and in appendages to railway engines and carriages. Sealed 4th November—6 months for inrolment.

Jules François Dorey, of Havre, in the Republic of France, Gent., for improvements in illuminating the dials of clocks and other instruments in which dials are employed. Sealed 4th November—6 months for inrolment.

Theodore Kosmann, of No. 16, Cranbourne-street, in the county of Middlesex, for improvements in brooches and other dress-fastenings,—being a communication. Sealed 4th November—6 months for inrolment.

Henry Hussey Vivian, of Singleton, in the county of Glamorgan, Esq., for improvements in obtaining nickel and cobalt,—being a communication. Sealed 4th November—6 months for inrolment.

Joseph Robinson, of the Ebber Vale Iron Company; Charles May, civil engineer, of Great George-street, Westminster; and William Thomas Doyne, civil engineer, of Euston-square Station, for improvements in the permanent way of railways. Sealed 4th November—6 months for inrolment.

George Dismore, of Clerkenwell-green, in the county of Middlesex, jeweller, for improvements in locks. Sealed 4th November—6 months for inrolment.

Robert Beswick, of Tunstall, in the parish of Wolstanton, in the county of Stafford, builder, for certain improvements in the making or manufacturing bricks and tiles, or quarries, and in constructing ovens or kilns for burning or firing bricks, tiles, and quarries, and other articles of pottery and earthenware. Sealed 4th November—6 months for inrolment.

Alexander Doull, of Greenwich, in the county of Kent, civil engineer, for certain improvements in railway construction. Sealed 6th November—6 months for inrolment.

Michael Leopold Parnell, of Little Queen-street, Holborn, in the county of Middlesex, ironmonger, for certain improvements in locks. Sealed 6th November—6 months for inrolment.

William Thomas, of Exeter, in the county of Devon, engineer, for certain improvements in the construction of apparatus and machinery for economizing fuel in the generation of steam, and in machinery for propelling on land and water. Sealed 6th November—6 months for inrolment.

William Sinclair, of Manchester, in the county of Lancaster, engineer, for certain improvements in locks. Sealed 13th November—6 months for inrolment.

Julian Bernard, of Green-street, Grosvenor-square, in the county of Middlesex, Gent., for improvements in the manufacture of leather or dressed skins, and of materials to be used in lieu thereof; and in the machinery or apparatus to be employed in such manufacture. Sealed 13th November—6 months for inrolment.

William Smith, of Derby; William Dickinson, also of Derby; and Thomas Peake, also of Derby, for certain improvements in the manufacture of chenille and other piled fabrics. Sealed 13th November—6 months for inrolment.

George Sheppard, of Stuckton Iron Works, Fording Bridge, in the county of Hants, engineer, for improvements in the construction of apparatus for grinding grain and other substances. Sealed 13th November—6 months for inrolment.

Hugh Bowlsby Willson, of the York Hotel, Blackfriars, in the City of London, Esq., for improvements in the construction of rails for railways. Sealed 13th November—6 months for inrolment.

William Charles Scott, of Camberwell, Gent., for certain improvements in the construction of omnibuses and other public and private carriages. Sealed 15th November—6 months for inrolment.

James Lott, of Whitchurch, in the county of Southampton, saddler, for improvements in harness and fastenings. Sealed 15th November—6 months for inrolment.

Charles Ewing, of Bodorgan, in the county of Anglesea, steward and gardener, for an improved method or methods of construction applicable to architectural and horticultural purposes. Sealed 15th November—6 months for inrolment.

Claude François Tachet, of Paris, in the Kingdom of France, mathematical instrument maker, for improvements in preparing wood to prevent its warping or shrinking. Sealed 15th November—6 months for inrolment.

Pierre Erard, of Great Marlborough-street, piano-forte maker, for improvements in piano-fortes. Sealed 15th November—6 months for inrolment.

Antoine Dominique Sisco, of Slough, for improvements in the manufacture of chains, and in combining iron with other metal, applicable to such and other manufactures. Sealed 15th November—6 months for inrolment.

William Hamer, of Manchester, for certain improvements in weaving textile fabrics. Sealed 15th November—6 months for inrolment.

Henry Bessemer, of Baxter House, Old St. Pancras-road, in the county of Middlesex, for improvements in producing ornamental surfaces on woven fabrics and leather, and rendering the same applicable to book-binding and other uses. Sealed 19th November—6 months for inrolment.

Federick Joseph Bramwell, of Millwall, in the county of Middlesex, engineer, for improvements in working the valves of steam-engines for marine and other purposes, and in paddle-wheels. Sealed 20th November—6 months for inrolment.

Thomas Statham, of Sidney-street, City-road, in the county of Middlesex, piano-forte maker, for certain improvements in piano-fortes. Sealed 20th November—6 months for inrolment.

Joseph Sharp Bailey, of Victoria-terrace, in Keighley, in the county of York, machine wool-comber, and Isaac Bailey, of Victoria-street, Bradford, in the county of York, book-keeper, for certain improvements in preparing, combing, and spinning wool, alpacca, mohair, and other fibrous materials. Sealed 20th November—6 months for inrolment.

Samuel Colt, of Bond-street, in the county of Middlesex, for certain improvements in fire-arms. Sealed 22nd November—6 months for inrolment.

Thomas Marsden, of Salford, for improvements in machinery for hackling and combing flax and other fibrous materials. Sealed 22nd November—6 months for inrolment.

Enoch Statham, of Siddals-road, Derby, for improvements in the manufacture of lace and other fabrics. Sealed 22nd November—6 months for inrolment.

Frederick Weiss, of the Strand, in the county of Middlesex, surgical instrument maker, for improvements in certain surgical instruments; also in scissors and other like cutting instruments,—being a communication. Sealed 22nd November—6 months for inrolment.

Frederick Benjamin Geithner, of Camden-street, Birmingham, for improvements in the manufacture of castors and legs of furniture. Sealed 22nd November—6 months for inrolment.

Jean Baptiste Chalmin, of Rouen, merchant, for improvements in preparing and weaving cotton. Sealed 22nd November—6 months for inrolment.

William Armand Moreau Gilbee, of 4, South-street, Finsbury-square, London, Gent., for certain improvements in the process of, and apparatus for, treating fatty or oleaginous matters, and in the manufacture of candles and other useful articles therefrom,—being a communication. Sealed 22nd November—6 months for inrolment.

George Mills, of Southampton, in the county of Hants, engineer, for improvements in steam-engine boilers, and in steam propelling machinery. Sealed 22nd November—6 months for inrolment.

Alexander Southwood Stocker, of Wandsworth, in the county of Surrey, Gent., for certain improvements in the stoppering or stopping of bottles, jars, pots, or other such like receptacles. Sealed 22nd November—6 months for inrolment.

Henry Ellwood, of the firm of J. Ellwood and Sons, of Great Charlotte-street, Blackfriars, hat manufacturers, for improvements in the manufacture of hats. Sealed 27th November—6 months for inrolment.

Richard Whytock, of Edinburgh, for improvements in applying colors to yarns or threads, and in weaving or producing fabrics when colored or party-colored yarns or threads are employed. Sealed 27th November—6 months for inrolment.

John Lee Stevens, of Kennington, in the county of Surrey, Gent., for certain improvements in propelling vessels on water. Sealed 27th November—6 months for inrolment.

CELESTIAL PHENOMENA FOR DECEMBER, 1851.

D.	H.	M.	
1			Clock after the ☉ 10m. 52s.
	—		☽ rises 1h. 33m. A.
	—		☽ pass mer. 6h. 56m. A.
	—		☽ sets Morn.
	14	0	☽ in Apogee
4	6	26	♄ in conj. with the ☽ diff. of dec. 2. 37. N.
	10	41	♅ in conj. with the ☽ diff. of dec. 4. 52. N.
5			Clock after the ☉ 9m. 18s.
	—		☽ rises 2h. 46m. A.
	—		☽ pass mer. 9h. 44m. A.
	—		☽ sets 3h. 47m. M.
7	6	46	♃'s third sat. will em.
8	3	27	Ecliptic oppo. or ○ full moon
10			Clock after the ☉ 7m 8s.
	—		☽ rises 5h. 43m. A.
	—		☽ pass mer. 1h. 7m. M.
	—		☽ sets 9h. 28m. M.
12	5	48	♃'s first sat. will im.
	10	34	♂ in conj. with the ☽ diff. of dec. 0. 42. N.
	12	3	☿ in conj. with ♀ diff. of dec. 1. 5. S.
	—		Occul. 83 Cancri, im. 9h 42m. em. 10h. 34m.
13			Occul. 37 Leonis, im. 10h. 24m. em. 11h. 13m.
15			Clock after the ☉ 4m. 47s.
	—		☽ rises 11h. 55m. A.
	—		☽ pass mer. 5h. 44m. M.
	—		☽ sets 0h. 36m. A.
	—		Mercury, R. A., 18h. 53m. dec. 25. 1. S.
	—		Venus, R. A., 18h. 52m. dec. 24. 9. S.
	—		Mars, R. A., 9h. 9m. dec. 19. 39. N.
	—		Vesta, R. A., 20h. 16m. dec. 22. 52. S.
	—		Juno, R. A., 18h. 59m. dec. 14. 6. S.
	—		Pallas, R. A., 3h. 4m. dec. 29. 33. S.
	—		Ceres, R. A., 6h. 57m. dec. 27. 27. N.
	—		Jupiter, R. A., 14h. 47m. dec. 15. 0. S.
	—		Saturn, R. A., 1h. 46m. dec. 8. 11. N.
	—		Uranus, R. A., 1h. 55m. dec. 11. 14. N.
15			Mercury pass mer. 1h. 19m.
	—		Venus pass mer. 1h. 18m.
	—		Mars pass mer. 15h. 32m.
	—		Jupiter pass mer. 21h. 9m.
	—		Saturn pass mer. 8h. 10m.
	—		Uranus pass mer. 8h. 19m.
	5	26	☽ in □ or last quarter
	17	13	♀ in Aphelion.
16	2	54	♂ stationary
	9	0	☽ in Perigee
	9	15	☿ in conj. with Juno
	18	28	♀ in conj. with Juno.
18	6	30	♃'s second sat. will im.
	18	7	♃ in conj. with the ☽ diff. of dec. 3. 52. S.
19			Occul. θ Libræ, im. 17h. 5m. em. 18h. 0m.
	22	10	☿ in conj. with ♀ diff. of dec. 0. 16. S.
20			Clock after the ☉ 2m. 19s.
	—		☽ rises 5h. 14m. M.
	—		☽ pass mer. 10h. 0m. M.
	—		☽ sets 2h. 35m. A.
20	6	51	☿ greatest elong. 20. 1. E.
21	21	9	☉ enters Capri.,—Winter com.
22	3	34	Ecliptic conj. or ● new moon
23	18	5	☿ in conj. with the ☽ diff. of dec. 0. 34. S.
	21	17	♀ in conj. with the ☽ diff. of dec. 0. 55. S.
25			Clock before the ☉ 0m. 11s.
	—		☽ rises 10h. 18m. M.
	—		☽ pass mer. 2h. 32m. A.
	—		☽ sets 6h. 52m. A.
27	12	51	☿ in the ascending node
	14	17	☿ stationary
28	4	4	♃'s first sat. will im.
29	11	0	☽ in Apogee
30			Pallas stationary
	—		Clock before the ☉ 2m. 40s.
	—		☽ rises 0h. 14m. A.
	—		☽ pass mer. 6h. 14m. A.
	—		☽ sets Morn.
	3	27	☽ in □ or last quarter
	21	0	Ceres oppo. to the ☉ intens. of light 1·299.
31	4	11	♄ stationary
	13	37	♄ in conj. with the ☽ diff. of dec. 2. 52. N.
	18	14	♅ in conj. with the ☽ diff. of dec. 4. 59. N.

J. LEWTHWAITE, Rotherhithe.

Fig. 8

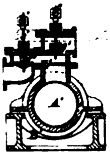
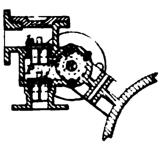


Fig. 9



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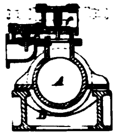


Fig. 11

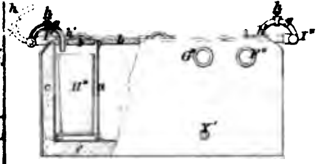


Fig. 10

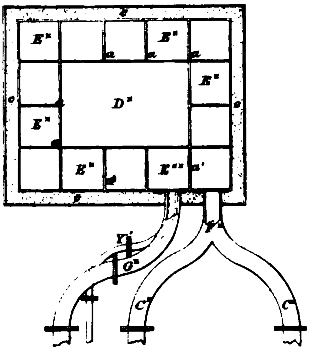
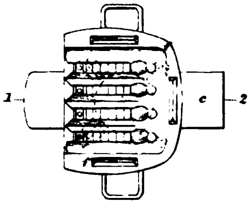


Fig. 17



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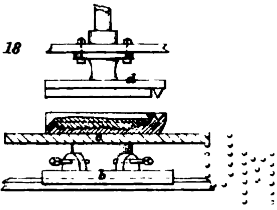

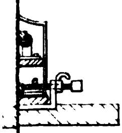

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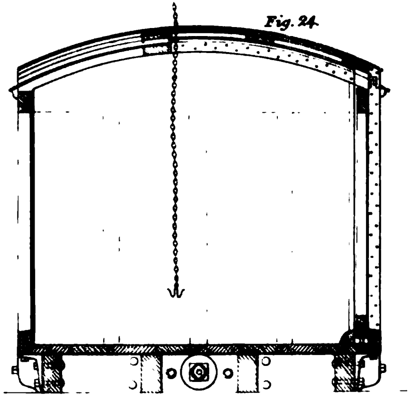

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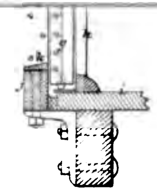

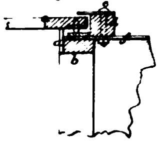

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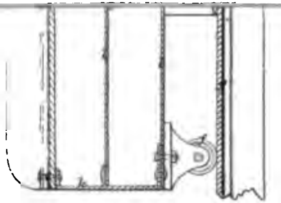

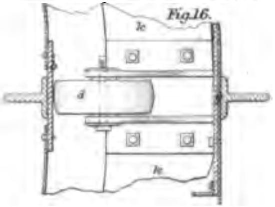

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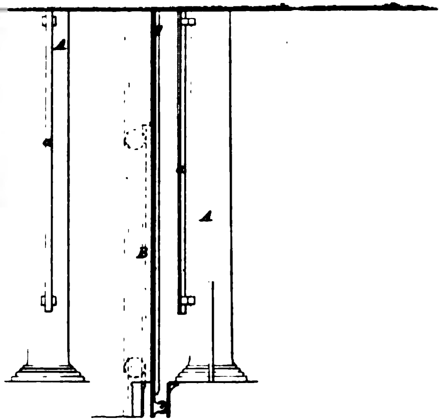

W. Newton del.

1st October 1851.

T. Sherratt Sc.

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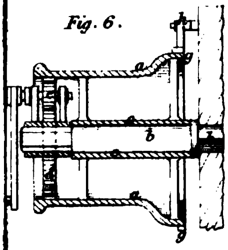
PLATE VI

Fig. 6.



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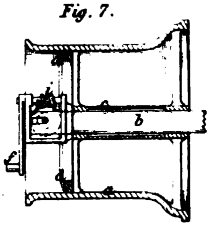


Fig. 13.

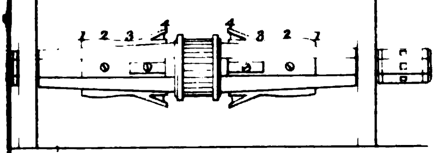
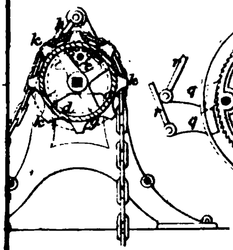


Fig. 8.



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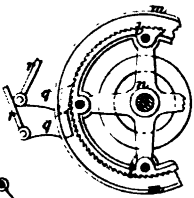


Fig. 11.

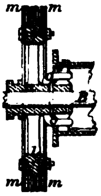
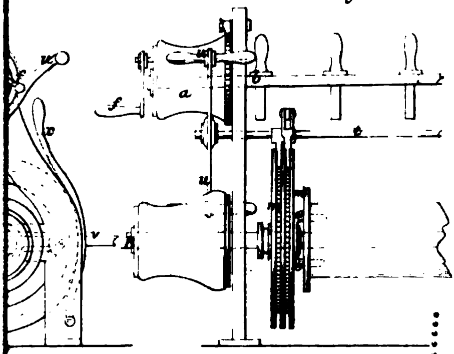


Fig. 9.



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